

**SIGNIFICANCE OF LOW LYING PUBIC TUBERCLE IN THE
DEVELOPMENT OF INGUINAL HERNIA**

**DISSERTATION SUBMITTED FOR
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MADURAI MEDICAL COLLEGE AND GOVT RAJAJI HOSPITAL
Madurai – 20**



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CHENNAI, INDIA.**

CERTIFICATE

This is certify that the dissertation entitled, **“SIGNIFICANCE OF LOW LYING PUBIC TUBERCLE IN THE DEVELOPMENT OF INGUINAL HERNIA”** is the bonafide work of Dr. S.Yashwanth Pradeep in partial fulfillment of the university regulations of the Tamil Nadu Dr. M.G.R. Medical University, Chennai, for M.S. (Branch I) General Surgery examination to be held in April 2017

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DECLARATION

I, Dr. S. Yashwanth Pradeep, hereby declare that, I carried out this work on,
**“SIGNIFICANCE OF LOW LYING PUBIC TUBERCLE IN THE
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Department of General Surgery, Madurai under the guidance of
Prof. Dr. D. MARUTHUPANDIAN M.S., FICS, FAIS., Professor and Head of the
department during the period of July 2015 to June 2016. I also declare that this Bonafide
work has not been submitted in part or full by me or any others for any award, degree or
diploma to any university or board either in India or Abroad.

This is submitted to the Tamil Nadu Dr. M.G.R. Medical University, Chennai in
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ABSTRACT

The dissertation submitted aims at the study of the significance of low lying pubic tubercle in the incidence of inguinal hernia. The study was done over a period of one year from July 2015 to June 2016 at the Govt. Rajaji hospital, Madurai. A group of 50 cases and controls were selected. After an informed consent from the patients, the distance between the anterior superior iliac spine and the distance between this line and pubic tubercle was marked and noted. These lengths were studied between the cases and controls and the significance was noted. The study proved the significance of the pelvic anatomy in the incidence of inguinal hernia. A note on clinical use of this study has also been postulated. The study also has got some secondary objectives on comparison of age, sex, risk factors, side, type and co morbidity.

Keywords: inguinal hernia, low lying Pubic tubercle, Types, Co morbidity, Associated risk factor

INTRODUCTION

The muscles, fascia and bones forms a complex structure called as the abdominal wall. Apart from the chief role of protecting the vital organs from external environment especially gastrointestinal and urogenital tract, also has a chief role in the mobility of the body like extension, rotation, flexion and change the wall capacity. Stretch and elasticity are the two major determinants of flexibility at the cost of the strength of the abdominal wall. The thoracic cavity is of negative pressures while the abdominal cavity which is positive pressure and they are separated by the diaphragm. The bowel may enter the thoracic cavity if the wall turns weak.

The lower part of the abdominal cavity is bounded by the bony pelvis, though strong has a central portion called as the perineum which may turn weak leading to the descend of pelvic and gynecological organs a condition called as the prolapse. Posteriorly the muscles of the wall are taut, further supported by the vertebral column, pelvis along with the ribs. Lumbar hernias are special entity of external hernias that occur through two zones of weakness called as the posterior triangles. In the lateral part of the abdominal wall, there are three muscle fibres which criss cross over each other to provide strength to the lateral wall of the abdominal wall. Surgeons use these layers for making incisions for surgery and making an overlapping repair of these muscle fibres, will increase the girth and help to close defects of the centre of the abdominal cavity.

From ribs to the bony pelvis extend two strong muscles called as the rectus abdominis of the central part of the abdomen. Though they are taut muscles, their central

portion is a weak zone called as the linea alba that zones the defect for paraumbilical and epigastric hernia. As the two rectus muscles split out, the central linea Alba stretches laterally a condition called as the diverication of recti, seen in the upper part of the abdomen, more commonly encountered in females after repeated pregnancies, elderly due to the weakness of the muscles and in the obese due to fat infiltration.

HERNIA

A hernia is the abnormal protrusion of a viscus or part of the same through a opening either in the containing wall of the viscus or within the cavity in which that viscus is normally located. The anterior and posterior walls, the diaphragm and the bony pelvic walls, all form the walls of the inguinal hernia. There are two types of hernia.

They are:

EXTERNAL HERNIA

External Hernia	Percentage
Inguinal hernia	80
Incisional hernia	10
Femoral hernia	5
Umbilical hernia	>4
Epigastric hernia	<1
Other hernia	<1

Among all spontaneous external abdominal hernias, inguinal hernia is the most commonly encountered type. Age old descriptions have been made of inguinal hernia. The causation of hernia is multifactorial with evolutionary, congenital, environmental, genetic factors and also the general state of health all contributing to its development. Anatomic variations of various structures facilitate herniation and have been assessed by clinicians. The course of a hernia going to irreducibility, obstruction or strangulation, makes it a life threatening emergency at times. The Africans compared to the Europeans are more prone to develop inguinal hernia due to the more oblique pelvis of them and this is due to the low pubic tubercle of the bony pelvis. Thus a study on this can help to throw light on the etiopathogenesis of inguinal hernia, life style modification and an appropriate treatment when needed.

AIMS & OBJECTIVES

AIMS:

To study the significance of the low lying pubic tubercle and the incidence of inguinal hernia and help to decide the type of repair that would benefit the patient.

Primary Objectives:

1. Establish the significance of the pubic tubercle anthropometry in inguinal hernia.
2. To derive at the best type of repair that could benefit the patient.

Secondary Objectives:

1. To study the incidence of different types of inguinal hernia.
2. To study the other risk factors associated with inguinal hernia.

Eligibility criteria

A. Inclusion criteria:

1. Any case of inguinal hernia irrespective of sex and occupation from 17 years to 70 years of age.
2. Patients admitted with other diseases were taken as controls
3. Patients who consented for the study according to the Performa.

B. Exclusion criteria:

1. The patient who have obvious associated causative factor for hernia, for example Urinary Outflow Obstruction.
2. Children below the age of 16 yrs were excluded from the study as the pelvis is not fully developed before this age & exact position of pubic tubercle cannot be forecasted due to the growth of skeletal system.
3. Controls having any pelvic fracture or anomaly were also excluded from the study by taking relevant history and doing thorough examination.
4. Patient not consented for inclusion in the study.
5. Patients with complicated inguinal hernia.

REVIEW OF LITERATURE

HISTORY

The earliest written citation to inguinal hernias is seen in the **Egyptian papyrus of Ebers circa** dated to 1500 BC. Different types of hernia and their correlation were mentioned in the early text of **corpus Hippocraticum dating back to 300 B.C.**

Taxis of a strangulated inguinal hernia have been mentioned by **Praxagorus of Cos** around the 4th century. **Chalcedon and Erasistratus of Keos** were also noteworthy surgeons of the same period.

Clinical manifestations of the strangulated inguinal hernia and the technique of inguinal hernia surgery was mentioned by **Celsus**, who lived in the city of Rome in the 1st century A.D.

A very early description of the cause of inguinal hernia that is by the weakness of the muscles of the abdominal wall was explained by **Claudius Galenus**, who lived from 129 to 201 A.D.

An elaborate study on the clinical features of a strangulated inguinal hernia was given by **Aretaios of Cappadocia**, who lived in the 1st century after Christ. On the other side few scholars also advocated the risk of surgery and one such person was Aetius around 500 A.D.

A detailed description of management of hernia was given by **Aetius** around 500 A.D. He suggested orchidectomy for all cases, irrespective of types.

Mondino de Luzzi was a scholar of surgery in Bologna. He revived the knowledge of anatomy and came up for surgical cure for hernia. Roland of Parma from around 1383 A.D. treated hernias with a position called Trendelenburg.

REVIEW OF NEW LITERATURE

“If we could artificially produce tissues of the density and toughness of fascia and tendon the secret of the radical cure of hernia would be discovered”. This statement, by a celebrated clinician of the day, of the *Beitrage zur Chirurgie et al* (1878). Mesh Repair was supported by his study.

Hernia repair was done with the help of gold wire that was called as the punctum aureum and the surgery called as the Royal operation, was done in the early 18th century. Lead wire was popularized by **Physick** (1816) in Philadelphia, while silver sutures were accepted by **Mettauer** (1832) and **Sims** (1849) to close vesicovaginal fistulae of women.

Use of natural suture material silk was brought by **Bassini et al** (1887). **Halsted et al** (1889) followed the same, but in 1894, he brought back the use of the silver wire due to the increased incidence of post herniorrhaphy sepsis and silver was used on

account of its known antimicrobial properties. His thought was further expanded in 19th century by **Witzel and Goepel et al** of Germany, who handmade silver filigrees, thus producing the first ever made mesh.

Nylon, the first ever synthetic fabric to be used widely. **Melick et al** reported its use in hernia, following clinical work by **Nichols and Diack** (1940). Monofilamentous nylon was then used by **Moloney et al.** (1948) in the most successful darn or shoelace type of hernia repair.

The nylon meshes were used for the first time during the Second World War in France and the efficacy of the mesh was studied by **Aquaviva and Bounet et al.** The prototype of the present day modern meshes was on the basis of the arrow shaped prosthesis of these years.

In 1955, **Francis C. Usher et al**, scholar of Houston, with specialization in pharmacology showed interest towards plastic prostheses after got minimal results with the dural grafts. Marlex was introduced, because of its large pore size and being incorporated despite the potent complication of infection. The wound gradually strengthened up to the span of 6 months.

A note worthy modification, polypropylene, was brought as a type of suture in 1962 and made into a prosthetic mesh. They are knitted, can be autoclaved and were

made durable with strong borders with a double way stretch. In the repair, it sets up inflammatory response first followed by fibrosis later, which increased the strength of the wound.

Dacron fibers on the other hand evoked a complement and macrophage-mediated inflammatory reaction. Failure of the mesh repair can occur in patients operated for incisional hernia during the early period of mesh repair that occurs due to the initial degradation of the mesh. **Leber et al.** (1998) advised negative remarks on Dacron use.

A Mersilene mesh was placed in the prefascial plane and inguinal repair was attempted by **Rives et al.** (1973). This space is readily available even after scarring when compared to that of the extraperitoneal zone that cannot be used in such a condition.

Irving Lichtenstein et al., practiced, published and familiarized the “tension-free repair.” The prospective randomized study of the subaponeurotic repair compared with the anterior preperitoneal repair for large primary type of inguinal hernia showed statistically low rates of recurrence and complications as others.

Preperitoneal placement of the prosthetic mesh came to be adopted by the pioneers in the mesh repair, such as **Usher, Rives and Wolstenholme**. The subaponeurotic positioning of mesh is not of good strength. If placed at the preperitoneal plane, then the rise in the intra-abdominal pressure will itself secure the prosthetic mesh to the wall (**Estrin et al.** 1963).

All types of femoral, recurrent inguinal, and the diverticular type of direct herniation (Type V) were managed with a rolled plug of polypropylene inserted from below studied by the **Lichtenstein and Shore et al**, in the year 1974 but later rejected because of increased morbidity. **Gilbert et al** (1987) plugged the deep ring for indirect hernia, while all hernia defects were managed in this manner with a reported success by Robbins and Rutkow (1993).

In 1938, **Plunkett et al** found the use of PTFE gas and a substance Teflon was adapted to hernia repair in 1959. But a large scale study showed the failure of the Teflon mesh and hence it was later abandoned. The use of Teflon was further expanded, when it was made into a strong porous substance by **Oshige** of Japan in 1962.

Ger et al. (1982) used clips and Schultz (1990) with prosthetic plugs but both failed due to an inadequate intraperitoneal fixation of the prosthesis. **Arregui et al.** (1993) made a note worthy work when they accepted the Stoppa's GPRVS using a TAPP repair for the hernia.

The most common procedure of the laparoscopic surgeons, with the totally extraperitoneal procedure (TEP), which is now accepted by most was studied and introduced by the **McKernan and Laws** in the year 1993. In the groin, laparoscopy is worth useful in the repair of both the bilateral and recurrent defects, since operation can be done bilaterally at the same time and nerves and the vessels are intact in the repair.

A anatomical maturation defect of collagen causing an inguinal hernia in rats induced with lathyrisms was studied by **Wirtschafter and Bentley et al in 1964.**

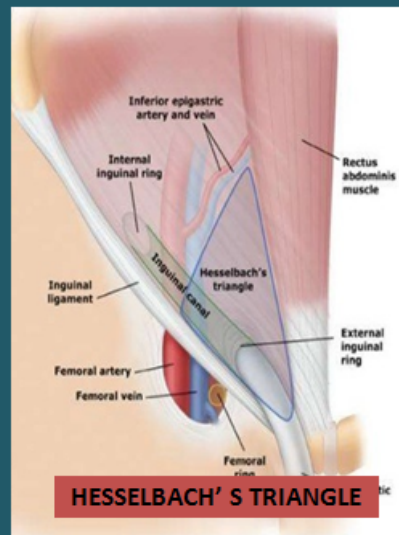
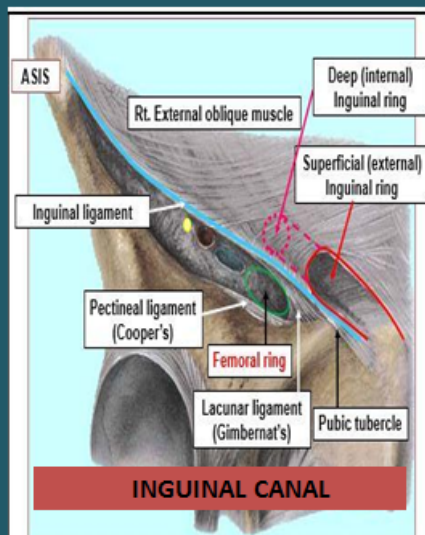
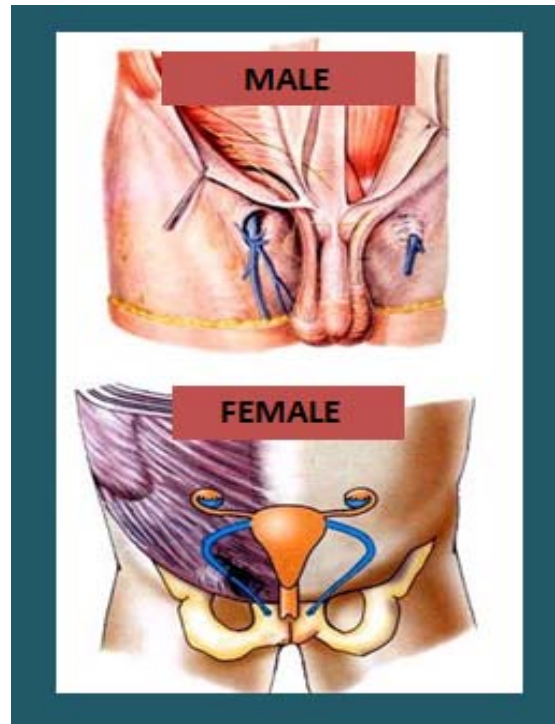
A defective variety of collagen that had a reduced Type I/III ratio was observed in the skin fibroblasts of the subjects with inguinal hernia was described by **Friedman et al.** in the year, 1993. Many premenopausal women suffering from genitourinary prolapse showed an increase in the tissue proteinases (MMPs) in the wall of the vagina was studied by **Jackson et al.** (1996).

ANATOMY OF INGUINAL HERNIA

Inguinal canal:

In children both the external and internal rings are superimposed without any type of obliquity of the inguinal canal. In the adults the length of the canal is 3.75 cms and it is called as the House of Bassini which is directed downwards and medially from internal to the external ring of the inguinal canal.

In males inguinal canal conduits the spermatic cord, ilio-inguinal nerve (outside the cord within inguinal canal) and genital branch of the genito-femoral nerve (within the cord). Internal spermatic fascia is a derivative of the fascia transversalis and the cremasteric fascia is a derivative of the internal oblique muscle and they form coverings of the cord. Spermatic cord contains testicular artery, artery of vas (branch of superior vesical artery which is derived from the anterior branch of internal iliac artery), cremasteric artery, pampiniform plexus of veins, genital branch of genitofemoral nerve, sympathetic plexus and lymphatics.



In females, inguinal canal contains round ligament, indistinct sparse cremaster, cremasteric vessels, genital branch of genitofemoral nerve and ilioinguinal nerve. Inguinal canal in female is called as *canal of Nuck*. Round ligament (in females) is much more intimately adherent to peritoneum.

- **External inguinal ring** is a triangular opening of the external oblique aponeurosis and is about 1.25 cm above the bony landmark of the pubic tubercle. The superomedial and inferolateral crus form the boundaries of the external ring. Normal superficial ring does not allow the tip of little finger.
- **Deep inguinal ring** is a U-shaped (or *Lambda* shaped) defect of the transversalis fascia, lies about 1.25 cm above the Inguinal ligament midway between the mid inguinal point.

Boundaries of Inguinal Canal

Anterior: External oblique aponeurosis and the conjoint muscle laterally.

Behind: Inferior epigastric artery, fascia transversalis and the conjoint tendon medially.

Above: Conjoint muscle (arched fibres of internal oblique).

Below: *Poupart's* ligament (Inguinal) and *Gimbernat* ligament (lacunar).

An indirect hernia (hernia through deep ring) travels down the inguinal canal on the anterolateral aspect of the cord; whereas posteriomedial to the cord, the direct

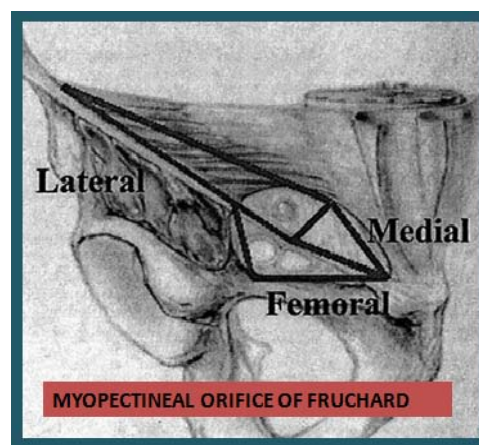
hernia comes out as a bulge. Neck of the indirect sac is lateral to the inferior epigastric artery but direct sac lies medial to the inferior epigastric vessels with a wide neck. Saddle-bag or pantaloon hernia sac is made of both medial and lateral component. In accordance to the pubic tubercle, the inguinal hernia is above and lateral while the femoral is found down and medial.

Direct hernia occurs through *Hesselbach's* (1814) triangle which is bound by the inferior epigastric vessels laterally, lateral border of the rectus abdominis muscle medially, the inguinal ligament inferiorly. The triangle is divided by the obliterated umbilical artery (medial umbilical ligament) into medial and lateral halves. So direct hernia is classified as *medial or lateral depending on which part of the Hesselbach's triangle, it is arising from*. The Lateral umbilical ligament is formed by inferior epigastric arteries. Medial type actually is called as *external supravesical hernia* and this fossa is called as *external supravesical fossa*.

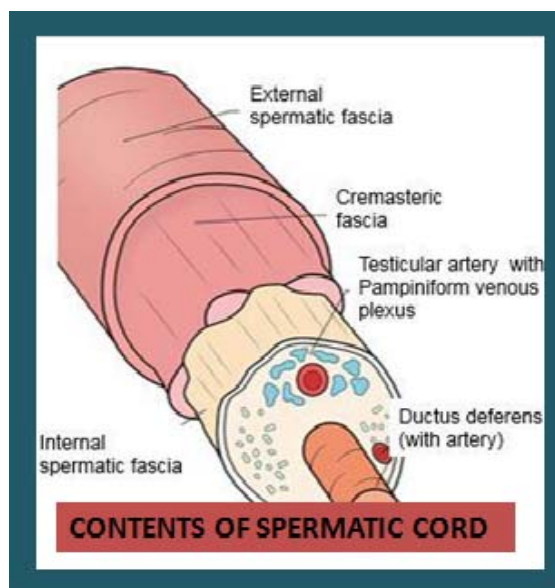
Myopectineal Orifice

The word was originally termed by Dr. Henri Fruchaud, and addresses to a "distinct area of weakness in the pelvic region". The term [Myopectineal] comes from different terms that are joined together. The root word [-my-] means "muscle" and the other word [-pect-] means "comb" or "pectinate". Fruchaud proposed that the abdominal wall is an inherent area that is congenitally weak, and is already being genetically determined.

The Myopectineal orifice is bounded superiorly by the muscle fibers of the transversus abdominis muscle and internal oblique muscles, and below by the pectineal line. The Poupart's ligament divides the MPO into two different zones; the suprainguinal region, coded by one single asterisk and site for the inguinal hernias to occur, and a small sub segment of the subinguinal zone, (coded by two asterisks), the femoral hernias occurs through them.



Contents of the spermatic cord:



- **Arteries:** the testicular artery, the deferential artery, the cremasteric artery
- **Nerves:** the nerve to cremaster muscle (genital branch of the genitofemoral nerve), the testicular nerves (sympathetic in origin) and the ilio-inguinal nerve- but Ilio-inguinal nerve is not inside spermatic cord, it runs only in the canal.
- **Vas deferens** (ductus deferens)
- **Pampiniform plexus**
- **Lymphatic vessels**
- **Tunica vaginalis** (remains of processus vaginalis)

All above said structures runs deep to the internal spermatic fascia except the ilioinguinal nerve that runs superficially on the external spermatic fascia.

ETIOLOGY OF INGUINAL HERNIA:

The etiology of any hernia is due to:

- (a) Weakness of the abdominal wall
- (b) Positive intra-abdominal pressure that pushes the contents into the weakness.

Sites of weakness

Weaknesses in the abdominal wall can be:

- **Congenital:** Example: A patent processus vaginalis or patent canal of Nuck, posterolateral or anterior parasternal diaphragmatic defects, patent umbilical ring of children.

- Where an intact anatomical organ passes through the abdominal wall – example: esophageal hiatus, umbilical ligament, obturator foramen, sciatic foramen.
- Acquired during life – example: surgical scar, region of any intestinal stoma, severe muscle wasting due to old age, fat infiltration of tissues by obesity, repeated pregnancy. Smoking causing alteration in the collagen morphology.

Raised intra-abdominal pressure

The circumference of the weakness is further increased by the increased intraabdominal pressure which stretches the wall both vertically and horizontally. Also, high Intraabdominal pressure forces the abdominal contents through a weakness. They include:

- Whooping cough of children and chronic cough associated with bronchitis and tuberculosis and Carcinoma lung in adults.
- Bladder outlet obstruction due to benign hypertrophy of prostate and Urethral stricture.
- Powerful muscular effort or heavy weight lifting.
- Chronic constipation
- Intra abdominal malignancy and any mass in the abdomen.
- Prolonged Vomiting.
- Repeated Pregnancy.

Risk factors pertaining to inguinal hernia in adults:

Factors that contribute to developing an inguinal hernia include:

Being male: Men are eight times more risk to develop an inguinal hernia.

Being older: Muscles weaken due to age.

Family history: Family history of muscle weakness and collagen vascular diseases.

Chronic cough: smoking, COPD and Other diseases of Lung

Chronic constipation: Constipation causes straining during bowel movements.

Pregnancy: Pregnancy can weaken the abdominal muscles and cause increased pressure.

Previous inguinal hernia or repair: higher risk of developing another inguinal hernia.

Risk factors pertaining to inguinal hernia in children

- Premature and low birth weight [less than 1.5 kg (3.3 lb)].
- History of associated undescended testicle
- Positive family history of inguinal hernia.
- Associated other birth_defects or conditions, such as an ambiguous genitalia, urethral anomalies epispadias or hypospadias or hydrocele.

PARTS OF AN INGUINAL HERNIA:

- Sac
- Contents of the sac
- Coverings of the Sac

SAC:

It is a pouch of peritoneum which comes out through the abdominal musculature.

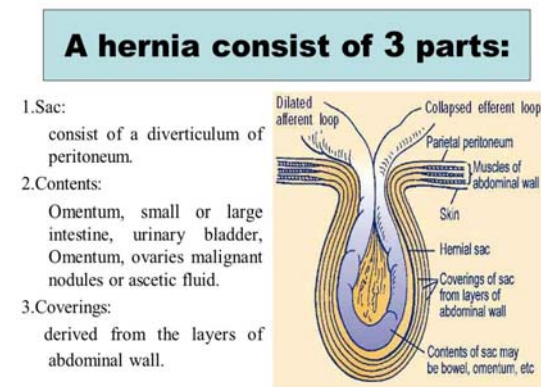
The sac is made of four parts. They are:

MOUTH: the opening of the sac through which contents enters

NECK: the most constricted part and it is the part which passes through the abdominal musculature

BODY: the main part of the sac

FUNDUS: the most redundant part of the sac.

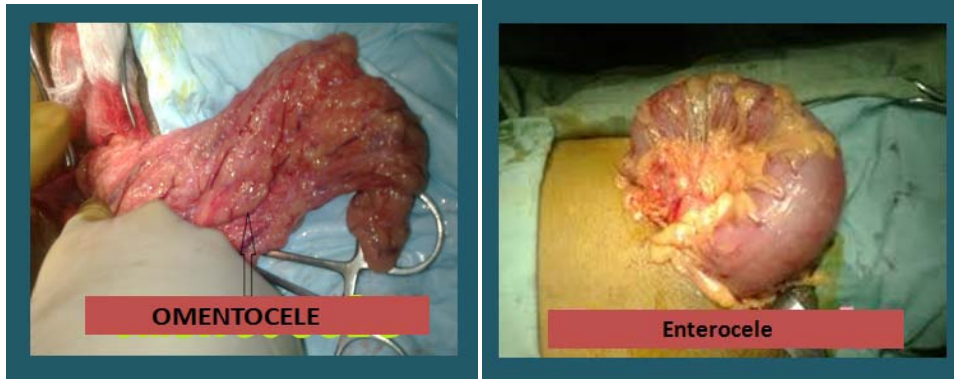


CONTENTS OF THE SAC:

Depending on the viscus the hernia can be divided into

Enterocoele

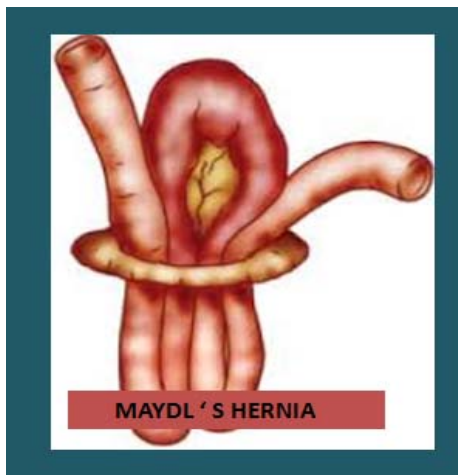
When the content of the sac is bowel it is called as Enterocoele.



Omentocele

When the content of the sac is omentum it is called as omentocele.

Maydl's hernia (Hernia-in-W)



This hernia is named after a Czech surgeon Karel Maydl. A rare type of hernia, with one loop of the intestine lying in the abdomen and two loops found in the sac., that is nearly in the form of a W and the central portion of the W can go for strangulation The strangulation can be of the intraabdominal loop alone or both intraabdominal and the loops in the sac. It is more in males, and more common on the right side. Maydl's hernia must be suspected in cases with any large incarcerated hernia and in cases with an

evidence of intra-abdominal strangulation or peritonitis. Taxis of the hernial contents are never done as it may result in gangrenous bowel being missed. The fallacy of the condition is that on opening the sac the coils of bowel appears to be normal and the diseased bowel inside the abdomen may be missed. Tenderness may be elicited above the inguinal ligament. Traction of the bowel loops may help to know the diagnosis.

Richter's hernia

A part of the circumference of the intestine (usually the anti-mesenteric border) enters the sac and is called as Richter's hernia. The herniated portion of the intestine may become ischemic. Because the intestine lumen is not obstructed, obstructive signs usually never occur, and there are only few symptoms till the ischemic part of the bowel perforates and produces the signs. Clinically it may resemble that of gastroenteritis. Constipation occurs only after paralytic ileus supervenes.

Littre's hernia



A Meckel's diverticulum may be the content of certain inguinal and they are called as the Littre's hernia. This type of hernia occurs commonly in a femoral or an inguinal hernia.

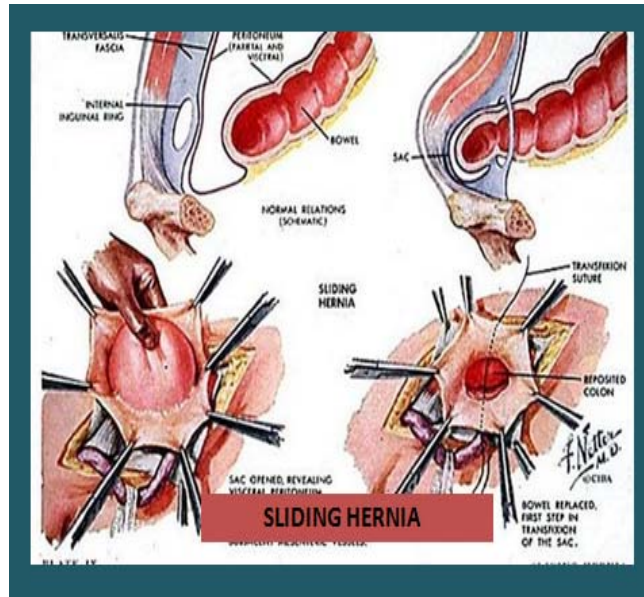
Sliding Hernia

A sliding inguinal hernia is the descend of any retroperitoneal structure through an abdominal weakness. Incidence of sliding hernias is around 5%. Sliding hernias are anatomically difficult for a surgeon to repair than other subsets of inguinal hernia. The difficulty in surgery to sliding hernias is the reason that the posterior wall of the hernial sac is not peritoneum but viscus itself, hence dissection can damage them. The contents may be the sigmoid colon on the left side, Caecum on the right side or the bladder on either of the sides. Currently the best used classification for this is the one given by Robert Bendavid.

Type I: Defined as any hernia in which part of the peritoneal sac is made up by the wall of any viscus.

Type II: Defined as any hernia containing a retroperitoneal viscus and its mesentery, in which mesentery forms part of the wall of the sac.

Type III: Defined as the sliding hernia containing a protrusion of a viscus itself and the peritoneal sac is very small or sometimes even may be absent.



Amyand's Hernia:



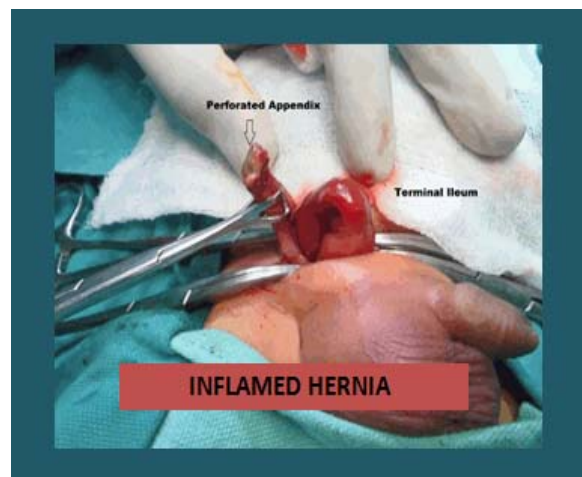
An inguinal hernia with a normal or a inflamed appendix is called as the Amyand' s hernia named in honor of the celebrated surgeon Claudius Amyand who recorded back the first case in the year 1735. Amyand's hernias generally present on the right side due to the normal position of the appendix. In rare cases associated with anomalies like situs inversus, malrotations of the intestines and a mobile caecum, a left

Sided Amyand hernia can occur. The clinical features of this type are tough to differentiate from a strangulated hernia.

Table 1: Classification of Amyand hernia and Athena's modification

Type	Losanoff - Basson Classification	Athena's Modification
1	Healthy appendix in hernial sac	Incidentally found healthy appendix in hernial sac
2	Amyand hernia with sepsis confined to scrotum	Hernial appendicitis with exclusive inguino-genital manifestation
3	Amyand hernia with sepsis spread beyond hernial sac	Hernial appendicitis with inguino-genital and abdominal manifestation
4	Amyand hernia with serious complicating pathology outside the hernial sac	Hernial appendicitis associated with ileocolic co-morbidity (such as Hirschsprung disease)
0	-	Hernial appendicitis manifesting primarily as occult sepsis

Inflamed hernia



When a hernia becomes inflamed it is called as inflamed hernia. It may be due to external abrasions or due to the content being an inflamed salphinx, meckel's diverticulum or an appendix. Constitutional symptoms along with signs of inflammation may be present. No features of obstruction and not tense helps to differentiate it from a strangulated hernia.

COMPLICATIONS

Most hernias are simple at the time of presentation. The three important complications of inguinal hernias are in the order of irreducibility followed by obstruction and by strangulation at the end.

Irreducibility

A hernia is said '*irreducible*' when the contents of the sac are not completely reduced.

Irreducibility can be due to

- (i) The wall of the sac and the contents develop adhesions,
- ii) Narrowing of the neck of the sac due to fibrosis or
- (iii) Transient stretching of neck and forceful movement into the sac of contents, which subsequently never returns to their original location due to a sudden rise in the IAP.

Irreducible hernias should be operated on as soon as possible. Although irreducibility is per se not a criterion for emergency intervention, obstruction can ensue at any time. These are almost always painful and it is a better option to operate.

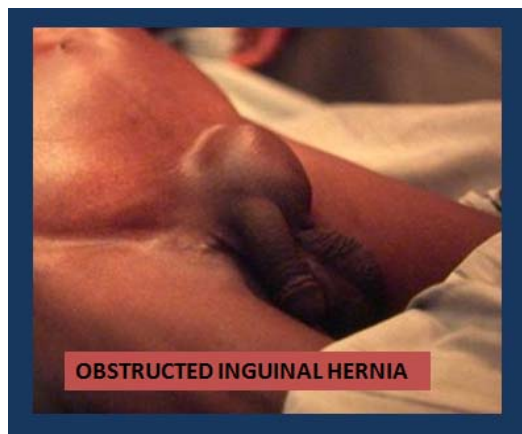
Obstruction

Obstruction occurs when the neck of the sac is narrow to occlude the lumen of the bowel inside the sac. Abdominal colic, vomiting, constipation and abdominal distension with a irreducible inguinal hernia gives clue towards diagnosis. Failure to do a thorough examination of the hernial orifices in a patient with acute intestinal obstruction may lead to the wrong procedure being done for the patient. Obstruction from

strangulation is difficult to differentiate by clinical features, and for this reason they are always emergency.

Features of obstructed hernia are:

- Expansile cough impulse absent.
- Hernia is irreducible.
- No complains of pain
- Hernia is lax and not tender.
- Features of intestinal obstruction.



Strangulation

The obstruction later progresses to a stage where the blood supply to the contents gets jeopardized and go for strangulation of the contents. Initially, lymphatic and venous obstruction occurs, leading to oedema and venous congestion only. When the tissue pressure equals arterial pressure, the arterial flow ceases and then gangrene ensues. Erythema is often a late sign that should not be waited for. Strangulated hernia is an emergency. A strangulated Richter's hernia, strangulated Littre s hernia and omentocoele are not preceded by features of intestinal obstruction and there may be only few local signs.

Features of strangulation include:

- Initial complains of pain and vomiting followed by generalized abdominal pain
- Absence of pain at the end marks the dreadful onset of gangrene bowel and paralytic ileus.
- Vomiting
- Patient is seriously ill and the hernia is tense and tender.

TYPES OF INGUINAL HERNIA

Direct inguinal hernia

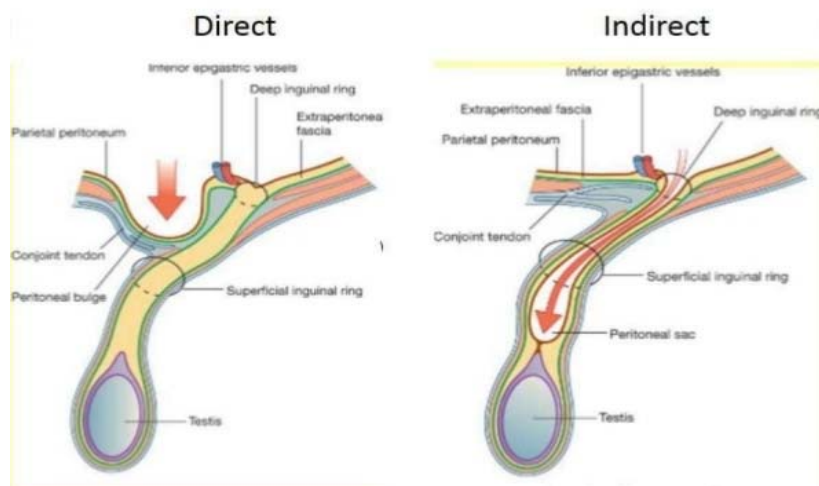
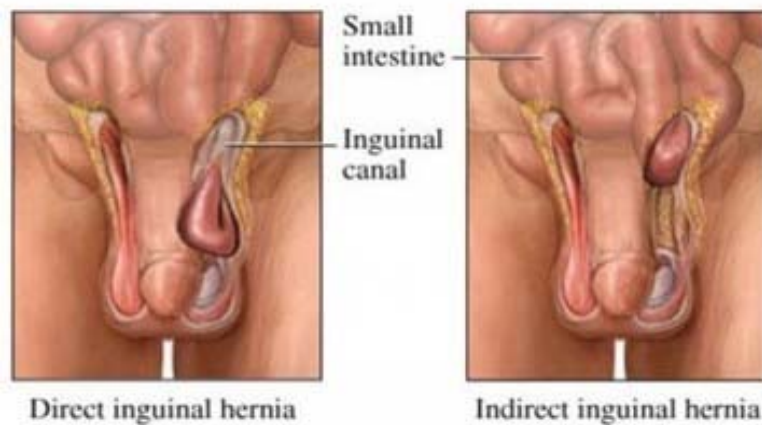
The direct hernia occurs through a weakness of the abdominal wall and the

location of the direct hernia is medial to the inferior epigastric vessels. The male to female incidence is about 10: 1. Hesselbach's triangle is defined as an area defined by the, the inguinal ligament on the inferior side, lateral border of the rectus abdominis muscle and on the medial side by the inferior epigastric vessels. It is this zone of weakness through which the direct inguinal hernia occurs.

The direct inguinal hernia extends down through the external ring and extends down into the scrotum. When both direct and indirect hernias are present on the same side they are called as pantaloon hernia and they are separated by the inferior epigastric vessels and they are dealt separately or as a single sac by ligating the vessels. Weakness of the abdominal wall due to increasing age has been associated with that of the direct hernia.

On the other side the indirect hernias are more common with the young age group, since their cause includes a congenital component where the canal is left more patent. Chances of direct hernia going for obstruction are very less and complications related to direct type are less as the neck is wide.

Added risk factors include smoking, causes of chronic constipation, overweight, chronic cough, and positive familial history of abdomen wall weakness and prior episodes of inguinal hernias. Direct hernia are uncommon in female sex and in children and a history of previous surgery is also significant in accordance with the appendectomy as there is a weakness of internal oblique and transverse abdominis muscles and this leads to a direct right sided hernia.



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Indirect inguinal hernia

Indirect hernia refers to herniation of viscus through the passage through which the testes entered the scrotum from abdomen called as the processus vaginalis. It passes through the deep and the external ring and can occur at any age with more preference to the young.

The passage of the testis from the abdomen to the scrotum is guided by the coat of peritoneum in the male fetus and it is called as the processus vaginalis and this normally obliterates at the end of the fetal life. The remnants of the peritoneum found with the testis are called as the tunica vaginalis. The testis derives its blood supply and the vas deferens all descend from a higher level of the abdomen down to the scrotum

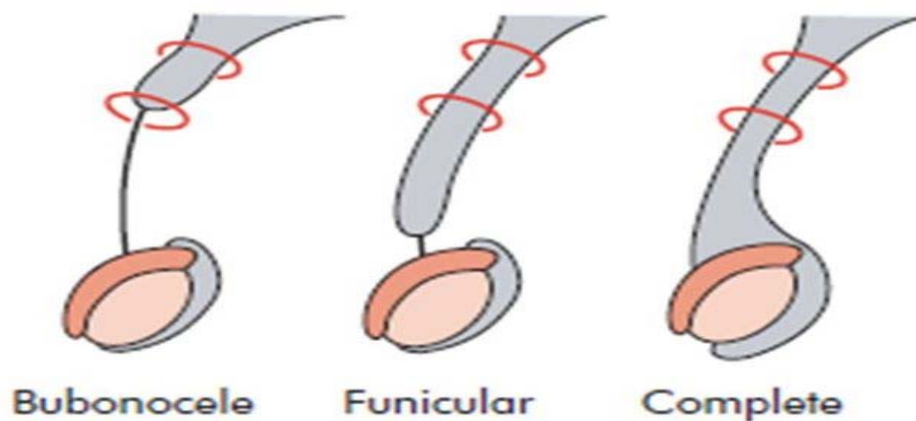
The defect in the fascia transversalis is called as the deep ring and is the beginning of the inguinal canal. A patulous deep ring marks the development of an inguinal hernia. The location of the indirect hernia is lateral to the inferior epigastric vessels and the conjoint tendon in the indirect hernia is usually strong and hence a tissue repair can be attempted.

There are three different types

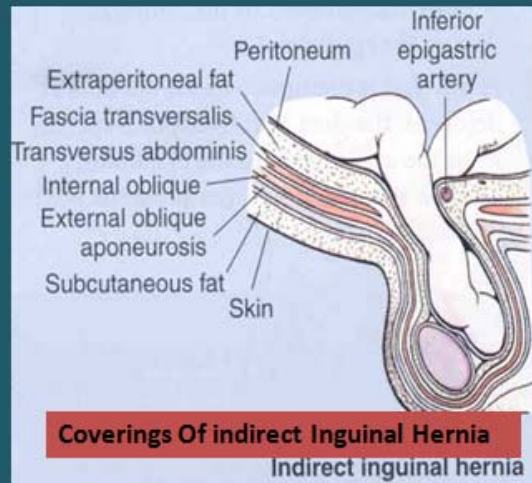
- **Bubonocoele:** the contents limited to the canal.
- **Funicular:** The processus vaginalis is patent up to the lower end and up to the epididymis and in this case the testis is separately palpable from the contents of the sac.

- **Complete (or vaginal):** here the processus vaginalis is patent throughout. The hernial sac is continuous with that of the tunica vaginalis of the testis. The hernia descends down to the bottom of the scrotum and it is difficult to differentiate the testis from that of the hernial contents.

The incidence of groin hernia is only 4% in the female sex. *Indirect hernia through a patent deep ring is the most common groin hernia of the females.* The content is just a hernial sac and not like the processus vaginalis of the male related to the testis and they reach the labia at the end of the progression if not treated the end.



Types of Indirect (oblique) inguinal hernia



Differences between indirect and direct hernia

feature	indirect	direct
age	children, young people	aged people
pathway of protrusion	coming down the inguinal canal, may enter the scrotum	pass through Hesselbach's triangle, rarely enter the scrotum
contours of sac	elliptic, pear-shaped	semispheric, wide base
compress the internal ring after reduced	controlled	not controlled
Reduced	Upwards, laterally and back ward	Upward and strait backward
Relationship of sac neck with inferior epigastric artery	Sac neck is lateral to it	Sac neck is medial to it
Incarcerated incidence	high	low

CLINICAL FEATURES

Age & sex:

Hernia can occur at any age. Children may present with hernia during early period of life. Young age is more favoring an indirect and Old Age a direct hernia. Direct hernia never occurs in females and children.

Occupation:

Most common in strenuous laborers.

Presenting Complaints

- I. About the hernia
- II. Due to hernia (Complications)
- III. Precipitating factors

About the Hernia

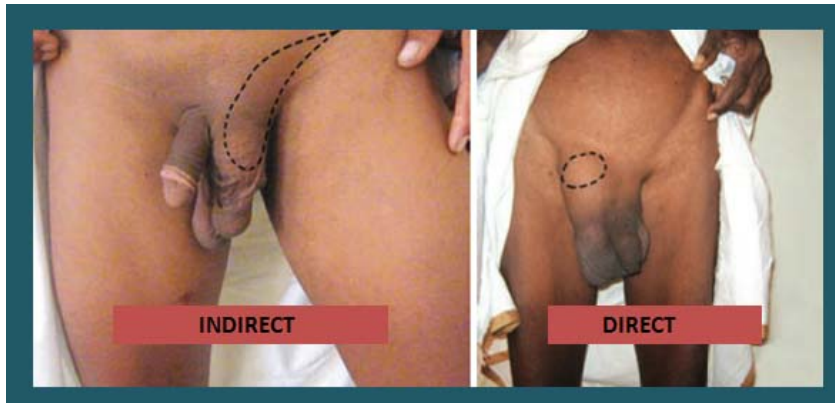
- 1. Duration of the swelling
- 2. Onset: Suddenly/gradually
- 3. Site of start:
 - From groin to scrotum (hernia)
 - From scrotum to groin (hydrocele and varicocele)

Aggravating factors:

—On straining, standing or coughing.

Relieving factors:

—By lying down or by manual reduction.



Associated with pain:

Usually painless. Pain in inguinal hernia is usually in the region of the umbilicus due to drag in the root of mesentery as bowel enters the sac.

Clinical features related to Complications

1. Irreducibility:

- i. Crowding of the contents
- ii. Adhesion between sac and contents
- iii. Adhesion between contents
- iv. Adhesion between sacs.

2. Obstruction:

Four cardinal features

- i. Colicky abdominal pain

- ii. Vomiting
- iii. Abdominal distension
- iv. Obstipation (Absolute constipation)—not passing flatus and feces.

3. Strangulation:

(Obstruction + irreducibility + Arrest of blood supply)

- i. Colicky abdominal pain if continues and becomes gangrenous pain disappears
- ii. Sudden increase in size of hernia; becomes tense and tender.

History of Precipitating Factors

- 1. Chronic bronchitis/asthma/TB
- 2. Difficulty in micturition
- 3. Difficulty in defecation
- 4. Weightlifting.

Past History

- Diabetes mellitus
- Hypertension/Ischemic heart disease/Bronchial asthma/Tuberculosis
- History of previous surgery
- History of appendectomy: Ilioinguinal or iliohypogastric nerve if damaged by grid iron incision or during keeping the drain; Direct Hernia Occurs If ilioinguinal nerve is cut in the inguinal canal, direct hernia never occurs. Because the nerve supplies the abdominal muscles before entering the canal.

Family History

History of connective tissue disorders in family.

Personal History

History of Smoking: Smoking leads to chronic bronchitis

Collagen deficiency occurs in smokers.

General Examination

Systemic examination

Cardiovascular System

Respiratory System

Abdomen:

- Mass abdomen
- Malgaigne's bulgings
- Ascites

Malgaigne's bulging are oval, longitudinal, bilateral bulging produced on straining, in inguinal region or above it; and are parallel to medial half of inguinal ligament. Present in direct hernia and it indicates poor muscle tone and signifies hernioplasty is the treatment.

LOCAL EXAMINATION

Inspection

Patient in standing position

1. Site

2. Size

3. Shape

 Pyriform—indirect

 Hemispherical—direct

 Retort—femoral

4. Extent

5. Surface

6. Skin over the swelling

7. Visible peristalsis

 Femoral—below and lateral to pubic tubercle

 Inguinal—above and medial to pubic tubercle

8. Cough impulse

 A demonstrable Propulsive and Expansible Impulse on Coughing.

Can be performed by:

 —Making the child cry

 —Valsalva maneuver

 —Head raising and abdomen contraction

To Demonstrate by Inspection:

- No need to reduce the content
- Just ask the patient to stand and cough

Inference

Swelling increases in size, or Impulse seen and swelling reappears

To Demonstrate by Palpation

Hold the right side of the root of scrotum with your left thumb and index finger without reducing the content and ask to cough. You will get expansile and propulsive impulse.

Absent cough impulse: Strangulated hernia

Incarcerated hernia

Neck of sac becomes blocked by adhesions

9. Draining lymph nodes

10. Penis

11. Urethral meatus

12. opposite scrotum

Palpation

1. Temperature

2. Tenderness Consistency: Soft elastic—intestine

Doughy granular—omentum

3. Site
4. Size
5. Shape
6. Extent
7. Surface
8. Skin over
9. Consistency
10. Reducibility
11. Get above the swelling
12. Cough impulse
13. Invagination test



Ring invagination test:

Only test in hernia; done in lying position.

Prerequisite:

—Swelling should be reducible

—Lax of skin should be there for invaginating (so this test could not be done in females)

Procedure

1. Reduce the swelling.
2. For right side, invaginate with right little finger into the superficial ring.
3. Rotate the little finger medially so that the pulp faces medially.
4. Note the direction of entry and site of impulse.

Look for:

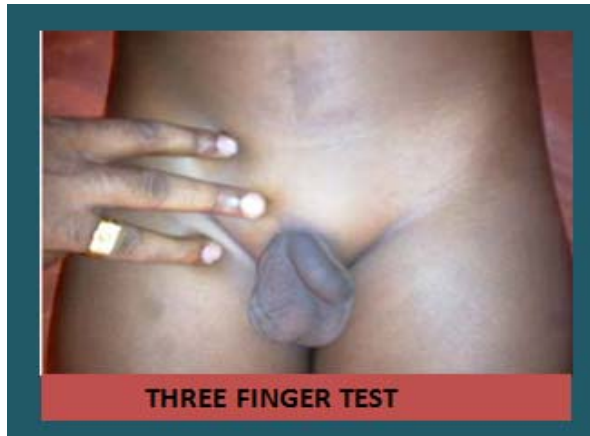
- Strength of superficial ring: Normal ring admits only the tip
- Direction of canal: Direct hernia—directly backwards Indirect—goes upwards, backwards and laterally
- Site of impulse: Pulp—direct Tip—indirect
- Strength of posterior wall
- To find early cases of hernia, impulse felt at tip

14. Ring occlusion test

After reducing the contents, patient in standing position, occlude the deep ring with thumb. Ask the patient to cough.

- If swelling appears - Direct
- Does not appear - Indirect

15. Zieman's technique



For right side inguinal hernia, place the right hand

- Index finger over deep ring
- Middle finger over superficial ring
- Ring finger over saphenous opening

See where the impulse is felt

- Direct hernia—superficial ring
- Indirect hernia—deep ring
- Femoral hernia—saphenous opening

Percussion

- Enterocele: Resonant
- Omentum: Dull

Auscultation

Peristaltic sounds occasionally heard.

Others tests:

1. **Testis:** 'Traction Test' to find whether the inguinal swelling is an Encysted Hydrocele of Cord.
2. **Epididymis.**
3. **Penis:**
 - Phimosis
 - Penile strictures
 - Pinhole meatus
4. **Regional nodes.**
5. **opposite groin.**

Per-rectal Examination

To Rule out:

1. Benign Prostate hypertrophy—micturition difficulty
2. Malignant obstruction
3. Chronic fissure—constipation

CLASSIFICATIONS USED:

Nyhus Classification System	
Type I	Indirect hernia; internal abdominal ring normal; typically in infants, children, small adults
Type II	Indirect hernia; internal ring enlarged without impingement on the floor of the inguinal canal; does not extend to the scrotum
Type IIIA	Direct hernia; size is not taken into account
Type IIIB	Indirect hernia that has enlarged enough to encroach upon the posterior inguinal wall; indirect sliding or scrotal hernias are usually placed in this category because they are commonly associated with extension to the direct space; also includes pantaloon hernias
Type IIIC	Femoral hernia
Type IV	Recurrent hernia; modifiers A–D are sometimes added, which correspond to indirect, direct, femoral, and mixed, respectively

- assesses not only the location and size of the defect, but also the integrity of the inguinal ring and inguinal floor
- most widely used classifications
- is limited by its subjectivity in assessment of distortion of the inguinal ring and posterior floor, especially laparoscopically.

Gilbert Classification

Type	Description
Type I	Small, indirect (<1.5 cm)
Type II	Medium, indirect, (1.5 cm to 4 cm)
Type III	Large, indirect (>4cm)
Type IV	Entire floor, direct
Type V	Diverticular, direct
Type VI	Combined
Type VII	Femoral

DIFFERENTIAL DIAGNOSIS

INGUINAL SWELLING

1. Enlarged lymph nodes
2. Undescended testis
3. Lipoma
4. Femoral hernia
5. Saphena varix
6. Psoas abscess
7. Femoral aneurysm

INGUINOSCROTAL SWELLING

1. Encysted hydrocele of cord
2. Varicocele
3. Lymph varix
4. Diffuse lipoma of cord
5. Inflammatory thickening of cord

INVESTIGATIONS

I. Routine

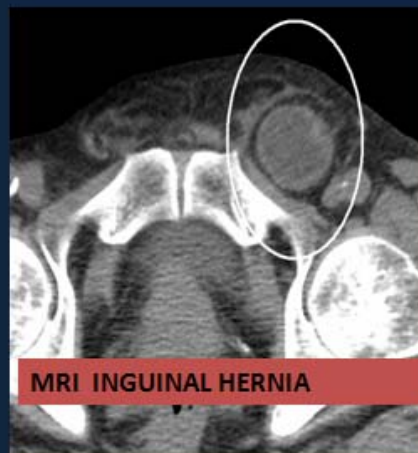
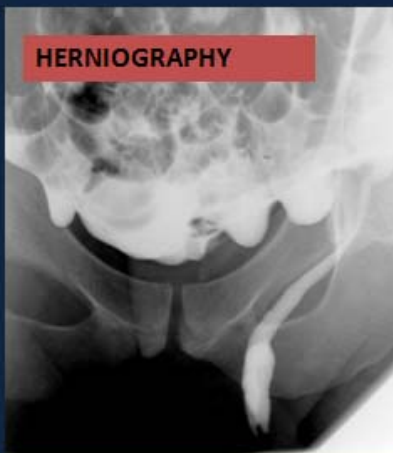
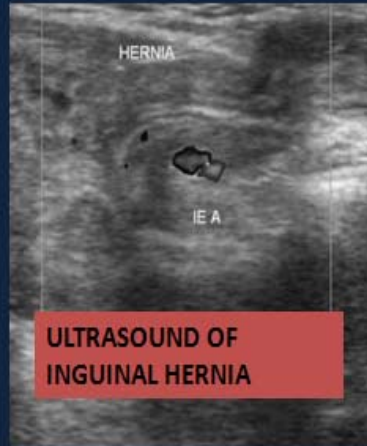
- Hemoglobin
- Bleeding time/Clotting time
- Total count, differential count, ESR
- Urine—albumin, sugar deposits

- Blood—urea, sugar
- Blood grouping/typing—for irreducible hernia/huge hernia

II. Anesthetic Purpose

- X-ray chest (Chronic TB, Asthma—precipitate hernia)
- ECG all leads

III. USG Abdomen and Pelvis



- In old age group—to find benign prostate hyperplasia calculate post-voidal residual urine. If >100 ml it is significant.
- To find any mass.

Ultrasound or a magnetic resonance imaging may be indicated in obese and sportsmen, though the diagnosis is almost always clinical. Presence of any other associated conditions or a recurrent hernia is also a indication for imaging .An occult hernia can be easily diagnosed with the help of a Herniography, but it is an invasive test and is rarely used with the advent of the MRI scans as they are also highly good in diagnosing an occult inguinal hernia.

History of Hernia Surgery

Original Eduardo Bassini (Padua, 1889) repair is though an anterior approach. He opened the posterior wall of inguinal canal and did a sutured three layered repair. In modified Bassini repair transverse arch is sutured to the shelving edge of the inguinal ligament as single layered interrupted sutures. De Chauviac differentiated inguinal from femoral hernias (1363).Kaspar Stromayr differentiated direct and indirect hernias in 1559. Ambroise Pare (1550) used trusses in hernia. John Hunter, Astley Paston Cooper (1841) Franz Hesselbach, Antonio Scarpa (1832), Pieter Camper, Jules Germain Cloquet (1883), Bogros, Retzius contributed in understanding anatomy of the groin.

La Roque, GL Cheatle, JP Hoguet, AK, Henry, McVay, McEvedy, Lotheissen, McArthur (used strips of external oblique aponeurosis to approximate conjoined tendon to inguinal ligament), Kirschner (used thigh fascial grafts), Gallie (used strips of fascia lata for repair using his specialized needle *Gallie's needle*), Handley (used silk with staylace darning), Meick (used first multifilament Nylon), Haxton (Used monofilament Nylon), Moloney (Nylon darn procedure, 1948) are the others who contributed to hernia surgery. Halsted (John Hopkins Baltimore) did four layered repair shifting cord anterior to the external oblique aponeurosis thus bringing superficial and deep ring directly very close causing higher chances of recurrence. EE Shouldice (1945) of Toronto did repair of transversalis fascia under local anaesthesia as a tension free 4/6 layered tissue repair.

Usher from Texas in 1958 first used Marlex mesh in posterior wall for repair as tension eliminating. Lichtenstein (1970) did rolled plug mesh repair of femoral hernia. Newman (New Jersey) did tension free inguinal hernia onlay mesh repair. Lichtenstein and Amid made this technique popular worldwide with certain modifications. Nyhus from Chicago and Condon from Milwaukee popularized open posterior repair from higher approach. Their technique probably became basis for TEP/TAPP. Stoppa and Rives (France) evolved giant reinforcement of the visceral sac by blocking Fruchaud's myopectineal orifice (MPO) bilaterally.

DIFFERENT SURGERIES

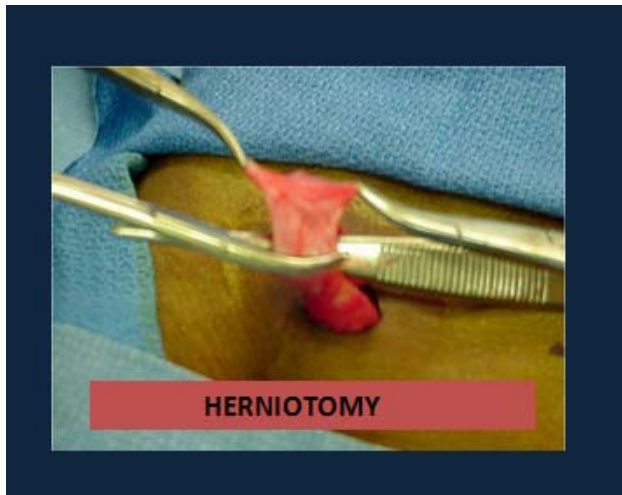
Herniotomy in Infants

In infants, whether it is hernia or Hydrocele, *only herniotomy* is done through inguinal approach (*Michaelis plank operation*). High ligation is the procedure of choice. Few advocated bilateral inguinal herniotomy in all children with either inguinal hernias on one side or both sides. Hernia here is due to the persistent processus vaginalis and always indirect. It is more common in boys (9:1); common on right side; 15% bilateral. Often presentation is like Hydrocele. It is often associated with undescended testis. Incarceration of bowel is very high in male infants with inguinal hernia. It is near 30% in premature or child less than 1 year. From 1 year to 18 years age group incarceration is around 15%. In girls, ovary and fallopian tubes are common content; strangulation of ovary is common. Conservative treatment should not be done in childhood inguinal hernia.

Inguinal canal approach:

Technique is same as in adults but more care and meticulous technique is needed. Superficial inguinal ring should not be opened to avoid the scarring of superficial inguinal ring. Vas deferens should not be held with hemostat or forceps. Fine non toothed Adson's forceps can be used if only needed. Whenever sac is complete distal part is left alone after transecting the sac; proximal part is ligated high above the level of the deep ring. Before ligating one should ensure that contents are pushed properly into the peritoneal cavity. Usually Hydrocele is due to infantile hernial sac and so there is no need to do a separate incision for Hydrocele; instead distal part of the sac is opened for an

adequate length, followed by removal of fluid content and later sac is left open like that. Separate Hydrocele or encysted Hydrocele if present, should be dealt through same incision.



Repair is not needed along the floor of the inguinal canal; and it will disturb the shutter mechanism if repair is done. Transversalis fascia should not be injured. *Very rarely* when direct sac is present posterior wall may be repaired by suturing conjoint tendon to inguinal ligament using 3 interrupted polypropylene sutures. But a surgeon should remember that *in children there is no repair in inguinal hernia*.

Inguinal incision without opening the inguinal canal approach:

In infants variation in approach can be undertaken but with difficulty. Here medial inguinal incision is made. Cord structures coming out of the superficial inguinal ring is identified without opening the superficial inguinal ring and external oblique aponeurosis. Inguinal canal in infant is very short with superficial and deep rings lying at same level. Sac once identified by careful meticulous dissection and traction can be

reached up to deep ring. Proximal sac is ligated with transfixation. Distal sac is left open. One should avoid injuring vas, testicular veins in the cord as they are very fine in infants. Use of bipolar cautery (not monopolar) is essential. Wound is closed in layers.

Complications:

- Recurrence (< 1%): Recurrence is due to injury to transversalis fascia (leads into direct hernia later), missed sac, improper ligation of the sac, sepsis, connective tissue disorders.
- Haematoma or seroma ,
- Injury to vas: If injury to vas occurs it should be repaired using 8 zero polypropylene sutures using microscope.
- Post Herniotomy Hydrocele,

In Adults

It includes *herniotomy* and *Herniorrhaphy or hernioplasty* (increasing the strength of the posterior wall by tissue repair or mesh repair).

Herniotomy

Anaesthesia: Spinal or GA or local anaesthesia.

Procedure

Under strict aseptic conditions skin incision is made half inch above and parallel to the inguinal ligament. Skin and the superficial layer of Camper and the deep layer of Scarpa are incised. Superficial pudendal and superficial epigastric vessels are ligated

with catgut or cauterized. Self retaining mastoid or similar retractor is placed to retract the skin edges. The aponeurosis of the external oblique muscle is cut along its long axis parallel to the line of skin incision. Incision is extended on either ends of the incision; medially it is extended to cut the margins of the superficial ring. Upper leaf is reflected above and held with hemostat; using peanut dissection upper leaf is raised adequately to visualize conjoined tendon and lateral rectus sheath. Lower leaf is then reflected downwards to visualize and expose the Poupart's ligament. Entire inguinal ligament is dissected medially and exposed with its shelving edge and Iliopubic tract.

Ilioinguinal nerve is safeguarded. Cremasteric muscle (box) with its fascia is opened longitudinally as medial and lateral flaps. Cremaster vessel is ligated and cremaster muscle is excised after ligating proximally and distally. Cremasterectomy is not essential. Even though it exposes cord and posterior inguinal wall well; it causes hanging testis without support (*clapper in bell*). Many advocate stitching the distal sutured part to pubic tubercle after cremasterectomy, so that it will give support to testis partially. It is not mandatory to excise entire cremaster. If there is a lipoma of the cord *it should be* excised; but normal fat in the cord should not be removed. If removed it may cause testicular oedema and hydrocele.

Cord structures are dissected with care. Herniotomy is done in the similar manner as in the infants. *High dissection beyond the deep ring* is always done. The fundus of the sac is opened. Finger is passed to break any adhesions if present. Sac is twisted so as to prevent the content from coming back. Transfixation is done and is excised (redundant sac) distally.

Hernia Repair

Repair may be

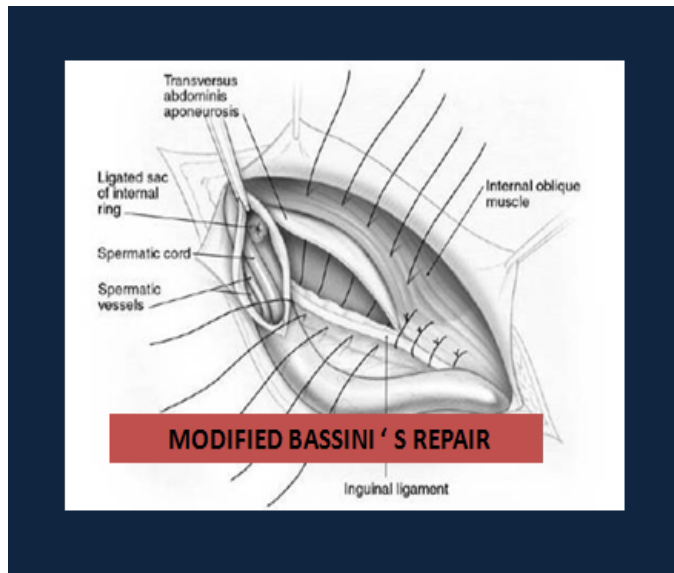
- *Pure tissue repair*: Shouldice, MacVay and modified Bassini
- *Prosthetic repair*: Lichtenstein, Rives, Gilbert, Stoppa, TEP, TAPP

It means repair or increasing the strength of the posterior wall . By principle defective first layer which is transversalis fascia should be used in repair. Strengthening can be done by tissue or prosthetic repair. Strengthening by tissue repair has got various upper part is approximated to Iliopubic tract or Cooper's ligament or shelved edge of the inguinal ligament. Upper leaf taken for repair should be tendinous fascioaponeurotic layer not fleshy red muscle. Non absorbable monofilament sutures like polypropylene should be used ideally. In few centers delayed absorbable sutures are used but it is not considered to be ideal. Prosthetic repair is done by placing mesh or prosthesis by onlay /inlay/ sublay intraperitoneal method. Tissue prosthesis like tensor fascia lata or temporal fascia is not used now. Polypropylene mesh is usually used with different modifications. Approach for repair may be ***anterior*** through inguinal canal (for tissue repair and mesh repair either onlay or sublay) or ***posterior*** through high suprainguinal preperitoneal.

Modified Bassini's Herniorrhaphy

Approximation of the inguinal ligament and the conjoint tendon by approximating with non absorbable sutures and the medial most bite is taken from the

periosteum of the pubic tubercle (*Called as key or Bassini's stitch*). Bassini originally used silk suture for the repair (1887). He also used triple layer of upper leaf which contains transversalis Fascia, transversus abdominis and internal oblique muscles in this repair. Iliac vessels should be handled with utmost care (mainly vein) while taking bite from inguinal ligament. It is often practiced to take bites in inguinal ligament at different levels to prevent tearing of the fibers of inguinal ligament. Laterally repair is done beyond the line of internal ring. Few advocate horizontal mattress sutures starting from conjoined tendon to inguinal ligament and from inguinal ligament to conjoined tendon.



Complications of Herniorrhaphy

- Hemorrhage, Haematoma or Infection (5%).
- Post herniorrhaphy Hydrocele, lymphocele or Haematocele.
- Hyperesthesia over medial side of inguinal canal due to injury to the vital ilioinguinal or iliohypogastric nerve.

- Osteitis pubis.
- Damage to urinary bladder/bowel.
- Testicular atrophy, penile oedema rarely can occur.
- Recurrence.

Lytle`s Repair (William James Lytle)

Narrowing of the patulous deep ring using interrupted sutures with polypropylene over medial side of the internal ring (thereby narrowing the ring and pushing the cord laterally).

Halsted (USA) – Tanner (London) Slide Operation

To avoid a tension repair a sliding tanner incision made over the lower part of the rectus sheath so that the conjoint tendon slides down without tension.

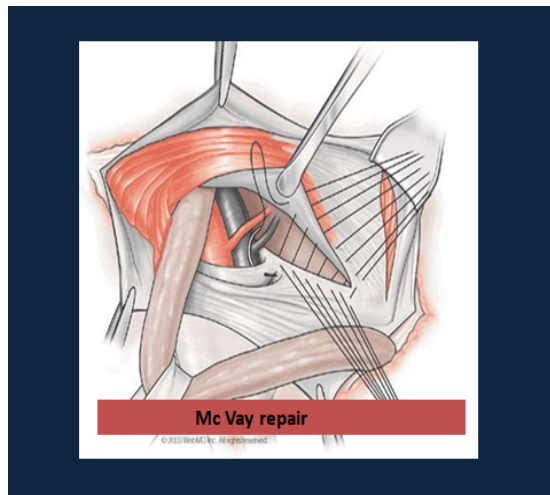
Koontz` operation (Koontz AR – New York, 1963)

Closure of the posterior inguinal canal in old people by performing an orchidectomy , removal of testis along with the cord structures after an informed consent.

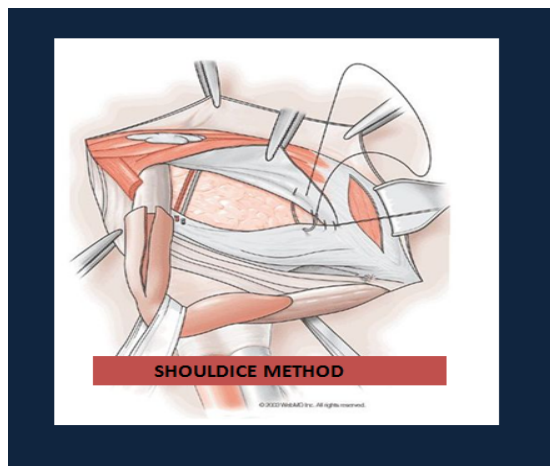
Mc Vay Operation – 1940 - (Cooper`s Ligament Repair)

It is repaired by placing interrupted sutures between the edge of transversus abdominis to Cooper`s ligament starting from pubic tubercle medially towards femoral sheath and later continued as suture repair between transversus abdominis and iliopubic tract laterally up to the entrance of cord. It is a pure tissue repair. It requires relaxing vertical/ curvilinear oblique incision at the lateral border of the anterior rectus sheath

from pubic tubercle to a point superiorly for 4 cm. It covers all three groin defects (myopectineal orifice)—indirect, direct and femoral.



Shouldice Repair



The posterior wall of the inguinal canal is strengthened by double breasting of the fascia transversalis, using the fascia, though it is a thin layer it is a highly durable layer. Multilayered repair is done in Shouldice repair. Continuous sutures provide *even distribution of tension* throughout the repair. Often cremasteric resection is done in Shouldice in order to have proper revelation of the posterior inguinal wall. After excision

of the sac, for Shouldice repair the fascia is cut open along the deep ring to the pubic tubercle. Upper medial flap is elevated without elevating lower lateral flap. If there is redundant part of the transversalis fascia it should be excised to leave adequate amount of clean cut edges. Four layered suturing is done.

Andrew's Operation

External oblique aponeurosis is double breasted.

Hernioplasty

Anterior transinguinal approach:

- Condon approach
- Rive's repair

Posterior approach

- Supra inguinal (Nyhus)
- Grid Iron: (Kugel's)
- Midline: Cheatle-Henry's-Stoppa's GPRVS
- McEvedy's: oblique incision (rectus sheath)
- Laparoscopic: TEP (Dulucq); TAPP (Arrigue/Dion and Morin)

Lichtenstein's Inguinal Hernia Mesh Repair

Indirect sac is dealt the same way as in the herniorraphy and if it is the Direct sac, it is pushed underneath. Transversalis fascia is identified and cut along the line of incision obliquely as medial lower and lateral upper flaps. It is common to do plication of

this fascia even though it is not mandatory. Inguinal canal is exposed well using Langenbeck retractor above and Czerny's retractor below and medially. Cord is kept away below. Polypropylene mesh is used for repair (10×6 cm size); size is decided based on the width of the defect; adequate sized mesh covering 2.5 cm above and medially should be used. Often mesh of required size is cut. Mesh is sutured below to the inguinal ligament; medial most sutures are taken from a point very close to the pubic tubercle. One should be sure that mesh covers well medial to the pubic tubercle (2 cm beyond). Size of the mesh used is usually 15×8 cm. Size should accommodate defect well beyond pubic tubercle (2 cm), superior margin (4 cm) and deep ring (6 cm) laterally. Presently it is thought that light weight large pore combined absorbable and non absorbable mesh is better than only non absorbable mesh. Suturing of mesh is done using interrupted non absorbable monofilament polypropylene or polyethylene sutures below to inguinal ligament.

Continuous sutures also can be used while suturing lower flap of mesh to inguinal ligament. Mesh is sutured inferiorly to the inguinal ligament up to the level of internal ring not beyond (if so femoral nerve may occasionally get injured). Laterally mesh is partially cut horizontally so as to enclose the cord and ilioinguinal nerve; lower flap of the cut part is narrower than upper flap. Lastly upper end of the mesh is sutured to the conjoint tendon in front with loose sutures (*air lock sutures*) just to keep mesh in place. It is often of practice to use absorbable sutures in these upper part so that nerve entrapment in case if occurs (iliohypogastric nerve) will get corrected or may not cause much problem; for same reason only loose sutures are used just to keep mesh in place (air

lock). It is also allowed to place continuous sutures below to inguinal ligament. But it is not ideal to place continuous sutures above. Mesh should be sutured with relaxation to bear the forward protrusion pressure of the transversalis fascia during standing. Cord and ilioinguinal nerve is placed back in the inguinal canal. External oblique is sutured using absorbable vicryl sutures. Subcutaneous and Skin is closed.

Different Types of Hernioplasty

Onlay mesh repair is placing mesh in front: It is sutured above to conjoined tendon and below to inguinal ligament using monofilament non absorbable suture material.

Inlay mesh repair is done by anchoring mesh deep to conjoined tendon at par with muscular or aponeurotic plane (*bridging*).

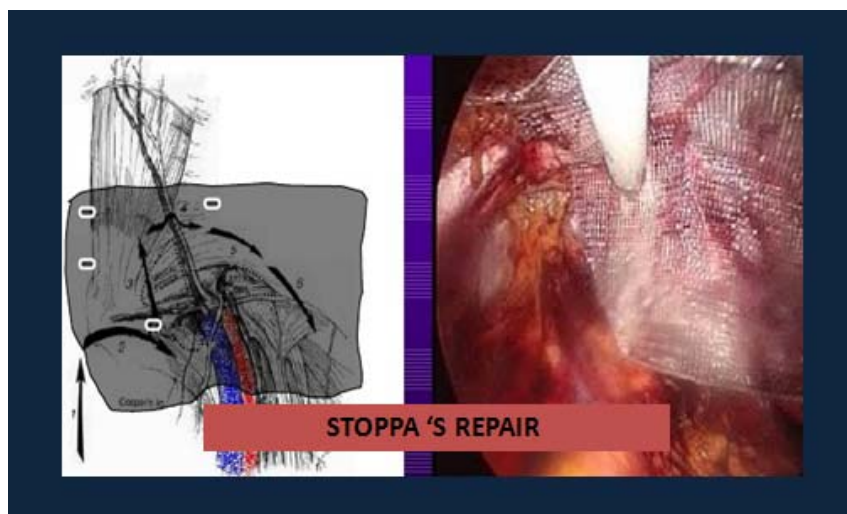
Lichtenstein tension free onlay mesh repair (1984) where the spermatic cord is encircled with mesh which is more often done under a local anaesthesia. Suturing of mesh is done similar to onlay mesh repair. It has got less recurrence rate.

Nyhus preperitoneal mesh repair (sublay)

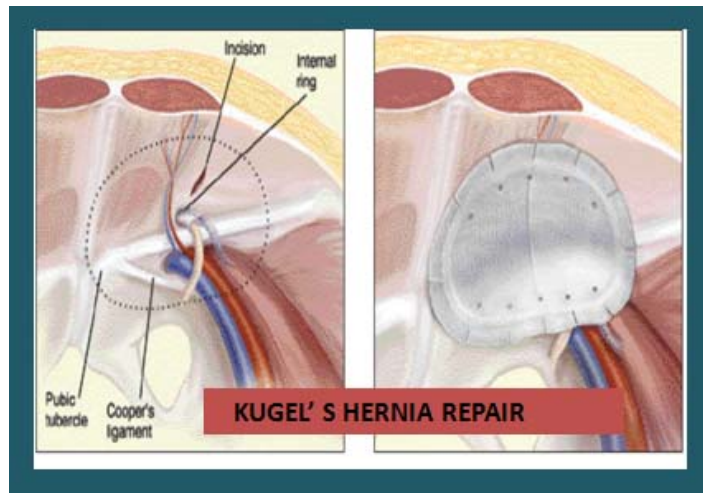
Using a posterior approach, by a suprainguinal incision, above the pubic symphysis and internal ring, this repair is done. Preperitoneum is approached through lateral border of the lower part of rectus muscle by making an opening in the posterior rectus sheath. Mesh is well anchored in the preperitoneal space deep to the spermatic cord, conjoined tendon, and the transversalis fascia. Inferiorly, it is folded deep to the Cooper's ligament and anchored with interrupted polypropylene sutures.

Stoppa's (Rene S Stoppa) giant prosthesis reinforcement of visceral sac

This is preferred in large hernias, elderly patients, both sides hernias, recurrent and even re-recurrent hernias, hernia with a weak abdominal wall, obesity and hernia with collagen diseases like Marfan's syndrome. Between the peritoneum and lateral, inferior, anterior abdominal wall the mesh is anchored, the mesh then stretches in the lower abdomen and pelvis. A subumbilical incision lower midline incision as a posterior preperitoneal approach across space of Retzius medially and space of Bogros laterally. Subumbilical midline incision is placed across skin, subcutaneous fascia rectus sheath. Peritoneum is not opened. Space of Retzius that lies in front of the bladder is dissected using finger and peanut swab. Dissection is continued towards *opposite side* of the surgeon first along the space of Bogros. Hernial sac/sacs whether indirect/direct or femoral sac are dissected off from their place. Funicular elements of sac along the vas deferens and testicular vessels are released so as to make complete parietalisation of the cord. Mesh is placed and spread along the myopectineal orifice, on lateral part and towards midline. Usually a very large mesh is placed without any kind of anchorage.



Kugel (Rober D Kugel) groin hernia mesh repair (sublay)



It is done through *posterior preperitoneal* approach with tension free less invasive sutureless repair. Kugel patch contains two overlapping layers of knitted polypropylene mesh which are attached to each other ultrasonically. Anterior layer of the mesh has got single transverse slit to facilitate the insertion. Multiple 3 mm holes through both layers of the mesh are present that allow tissue contact in better way to prevent mesh displacement. Small V shaped triangular cuts on the anterior layer adjacent to these multiple holes act as sutureless anchors. Incision is above the deep ring and lateral to inferior epigastric vessels. Midpoint of the inguinal ligament is marked. *Oblique incision* just superior to this point is made and split down to reach deeper space. Transversalis fascia often which is two layered is split vertically to avoid injury to inferior epigastric vessels. Preperitoneal space is created first superiorly then laterally. As approach is small, proper malleable retractors are necessary. Dissection is carried out down under the pubic

bone across Cooper's ligament. Kugel's mesh patch is placed properly without allowing any tissue bands folding it. Transversalis fascia is sutured with one absorbable suture.

Anatomical Considerations for laparoscopic repair

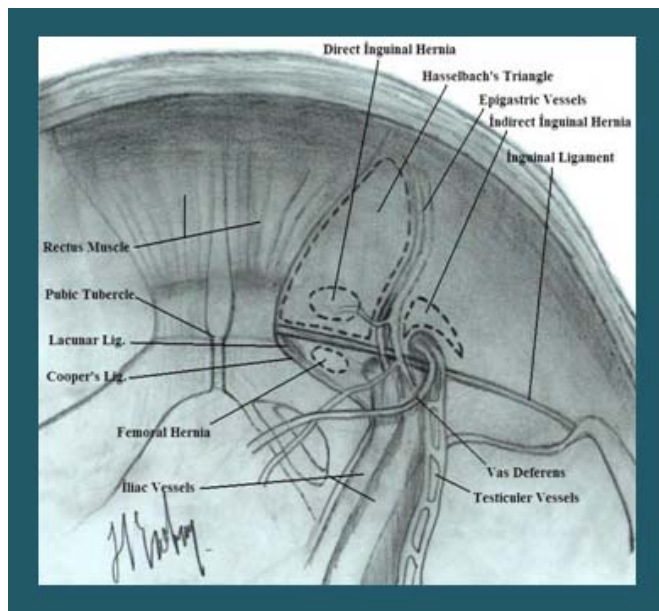
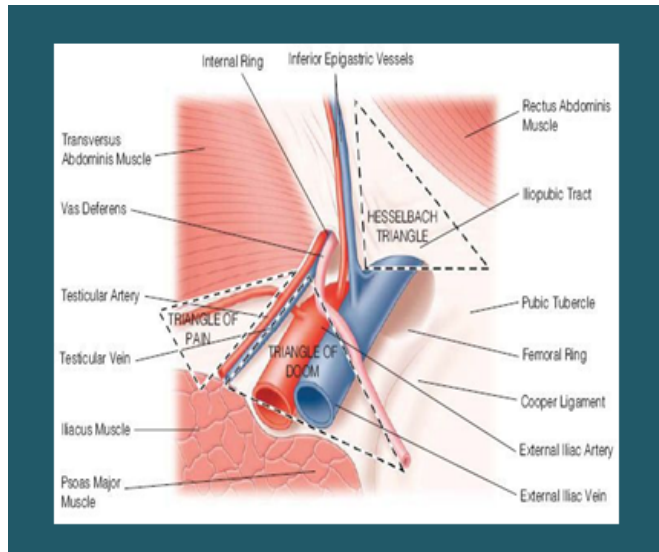
The Preperitoneal space is space that lies in anterior to the peritoneum, posterior to the transversalis fascia and the anterior rectus muscle. The space that lies in front of the urinary bladder is called as the **Space of Retzius**, medially and this space laterally extends down called as the **Space of Bogros**.

The Median umbilical fold is formed by urachus in the midline. **Medial umbilical ligament** is a derivative of the obliterated umbilical arteries, **lateral umbilical fold** derived from the inferior epigastric vessels. Three different fossae lies in relation to these folds— suprapubic and medial fossae are medial to the lateral umbilical fold which are potential sites of direct hernia whereas lateral fossa is lateral to the lateral umbilical fold and is site of indirect hernia.

The **myopectineal orifice** bounded laterally by iliopsoas muscle, medially by the border of rectus abdominis, inferiorly by the pectin pubis and superiorly by conjoint tendon was first described in the year 1956 by Fruchard. The myopectineal orifice is covered along its entire dimensions with an adequate mesh in order to avoid any groin hernia of the body.

A triangle formed by the vas deferens medially, gonadal vessels laterally and the peritoneal reflection inferiorly is called as the ***triangle of doom***. The external Iliac vessels are the content of this triangle. An occasional branch of inferior epigastric artery,

Aberrant obturator artery replacing its pubic branch travels across the Cooper's ligament, when accidentally injured during the hernia repair causes an excessive bleeding and may even be fatal , hence called as the *circle of death*.



The Iliopubic tract laterally, the gonadal vessels medially and the peritoneal reflection below forms the **triangle of doom**. Genitofemoral nerve and the lateral

cutaneous nerve of thigh are contents of this triangle. The damage during surgery either by dissection or by tackers causes inguinodynia.

Transabdominal preperitoneal mesh repair (TAPP-sublay) using laparoscope

This is usually used in large indirect hernia or irreducible inguinal hernia. A umbilical port and 5 mm ports on pararectal point at or above the level of the umbilicus one on each side are used so as to achieve an adequate triangulation. Reduction of the hernial contents is done. Dissection of the hernial sac in the preperitoneal plane after making a curved horizontal incision at the upper part of opening of the sac. Incision over the peritoneum is made from lateral to medial. From a point around 3-4 cm lateral to lateral umbilical ligament (inferior epigastric vessels) horizontal incision is made across internal ring on its upper part medially up to medial umbilical ligament. Preperitoneal space is dissected to identify pubic bone, Cooper's ligament, vas deferens, gonadal vessels, and the inferior epigastric vessels. After completing the dissection and excision of the sac a prolene/vipro/ultrapro mesh of size 15 × 10 cm is placed in the preperitoneal space. It is then fixed to the pubic bone/ Cooper's ligament by tackers. Peritoneum is then closed in a continuous manner from lateral to medial.

Totally Extra Peritoneal Repair (TEP Repair) Using Laparoscope

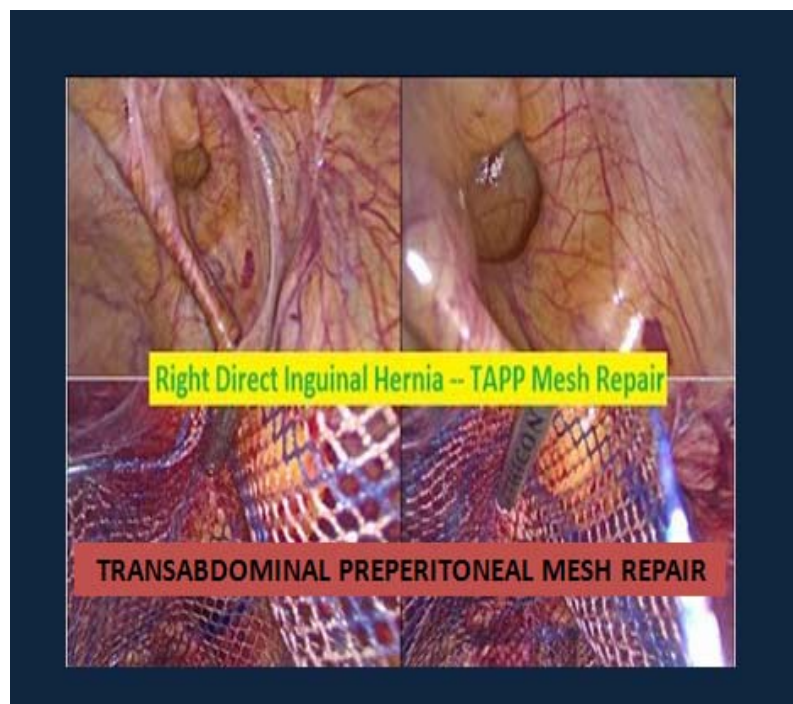
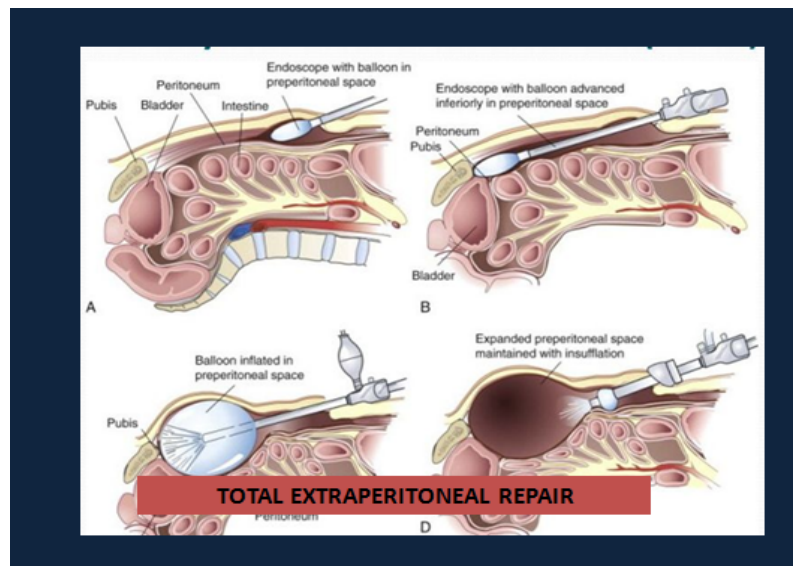
Through subumbilical vertical/horizontal incision (10 mm) extra peritoneal space is reached. Often special type of balloon is used to create the same. *Cobweb space* is avascular and easily identifiable. Touching of the telescope over the hard pubic bone can

be felt during dissection. Further dissection allows visualization of the bone as *light house sign*. Immediately laterally Cooper's ligament can be identified. After CO₂ insufflation, another 5 mm port is inserted 4 cm below the first port at the midline. It is often better to put a hypodermic needle (needle of a syringe) into the space from midline to identify the site of the further ports. Third 5 mm port is inserted in the same line 4 cm below or in the right iliac fossa. Dissection is carried out downwards carefully, then medially up to pubic tubercle, ilio-pectineal ligament, laterally to the iliac vessels, and the inferior epigastric vessels. Direct sac when present is immediately visualized. It is dissected proximally by traction and counter traction over the white pseudosac in front.

Entire sac should be dissected down and behind to visualize wide direct defect medial to inferior epigastric vessels. One should remember that inferior epigastric vessels are properly seen only after dissection of the sac in case of direct one. Whereas in indirect sac, first inferior epigastric vessels are seen; then peritoneal sac is seen lateral to it running upwards, medially and proximally in the anterior abdominal wall. Usually entire sac can be dissected proximally. One should avoid opening peritoneum as it reduces the extraperitoneal space to undertake further part of the procedure. Mesh is passed through 10 mm port using a reducer after removing the telescope. If difficulty arises in passing mesh then port knob is removed and mesh is directly pushed into the space through the port. A 15 × 15 cm sized mesh is placed after a adequate dissection for the mesh to be placed.

Different port approaches and port placements are used for TEP

1. *Duluq approach.*
2. *McKernan's method.*
3. *Phillips TEP using initial peritoneoscopy.*



MANAGEMENT OF STRANGULATED INGUINAL HERNIA

Patient with strangulated inguinal hernia presents with irreducibility, pain and tenderness, distension of abdomen, vomiting, and toxic features. Initial resuscitation is done with nasogastric aspiration, fluid and electrolyte therapy, antibiotics, urinary catheterization. Erect X ray abdomen may show multiple air fluid levels.

Emergency surgery is needed under general anaesthesia. Inguinal incision extending into the groin is placed. Incision is deepened to reach the external oblique aponeurosis which is cut across the superficial inguinal ring. Incision is extended and deepened downwards along the root of the scrotum. Sac is identified and held. One should also hold the contents in the sac so as to prevent contents getting reduced and also toxic fluid spilling into the peritoneal cavity. Sac is opened carefully; all toxic fluid in the sac is sucked out thoroughly. Content, either bowel or omentum is held with Babcock's forceps. Viability of the bowel is checked by its color, texture, peristalsis, mesenteric pulsation or when in doubt by giving 100% O₂ to the patient or after covering the bowel wall using hot mops.

If bowel is not viable resection and anastomosis is done. For this, incision may be adequately extended laterally along the lateral abdominal wall. Closing this wound and separate laparotomy incision is not mandatory. Anastomosis is done using interrupted single layer silk or vicryl sutures. *Strangulated omentum* is not uncommon which is treated by omentectomy. *Drains* are placed into the peritoneal cavity as well as into the inguinal wound. Inguinal canal is strengthened by *modified Bassini's repair* using interrupted monofilament polypropylene sutures. Prosthetic mesh is not used as

field is contaminated. In later period if hernia recurs then prosthetic mesh is used for repair. Biological mesh can be used during the surgery for strangulated hernia.

Problems in strangulated hernia are:

- Sepsis, leak and fistula formation,
- Post operative ileus or peritonitis
- Wound infection and intraabdominal abscess formation like pelvic or subphrenic.
- Electrolyte imbalance and respiratory complications.

SURGERY OF INGUINAL HERNIA IN FEMALES

Commonest groin hernia in females is inguinal hernia. Often it may contain Fallopian tube or ovary. Round ligament is attached to labia. Sac is in close relation with round ligament. Sac is adherent and is often difficult to dissect. It is invariably indirect sac.

Direct hernia is rare in females. Surgery is the treatment. Laparoscopic or open approach can be used. Round ligament is excised and inguinal canal is entirely closed. Mesh is placed in preperitoneal plane. That also prevents femoral hernia to develop. Incision and technique are same. Bilateral inguinal hernia can be treated surgically in same sitting.

RECURRENT INGUINAL HERNIA:

Causes of recurrence

- Types of hernia
 - Sliding hernia, large and long standing hernia and large direct hernia
- Types of patients
 - Patients with persistent precipitating factors.
 - Weak abdomen wall
- Operative faults
 - Tension anatomical repair
 - Use of absorbable sutures
 - Imperfect hemostasis
- Fault in the selection of the procedure.
- Postoperative care
 - Infection
 - Heavy weight lifting
- Appearance of new hernia

Table 1. Rerecurrence Rates after Open Inguinal Hernia Repair Using Various Mesh Techniques

Hernia repair	Rerecurrence rate (%)
Lichtenstein onlay	1.3–8 ^{45,46}
Plug and patch	3.5–6 ^{17,24}
Prolene Hernia System	NA
Open posterior approach	5.9–9.7 ^{47,48}
Kugel	27.8 ⁴⁹

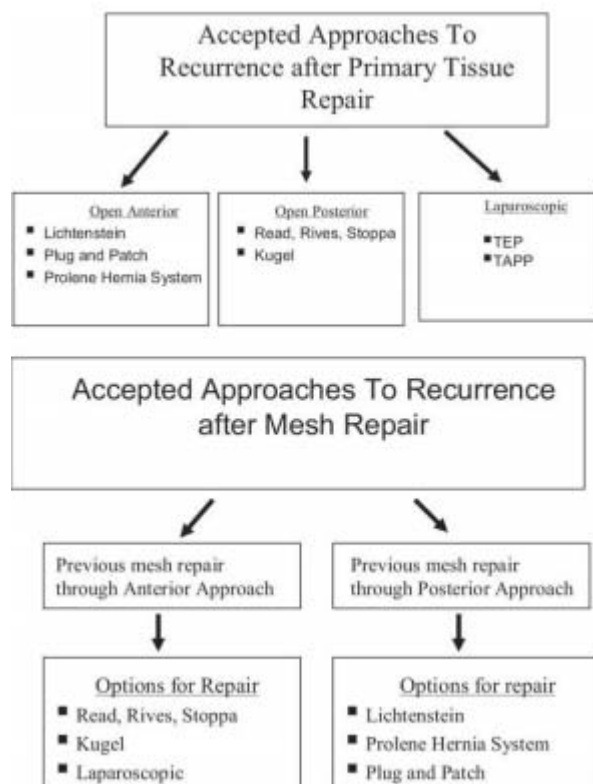
Open approach of a recurrent inguinal hernia

The knowledge of the anatomy of the groin especially of the myopectineal orifice is needed in the surgery of the recurrent inguinal hernia. Identification of the myopectineal orifice and covering it along its entire dimensions stays to be the major goal of the recurrent inguinal hernia repair.

POSTULATES OF LICHTENSTEIN IN RECURRENT HERNIA REPAIR

1. The fascial structures are distorted and no attempts to reinforce them are done.
2. Any type of inguinal hernia the entire floor has to be repaired;
3. No tension sutures;
4. No use of devascularized or scarred tissues for recurrent repair;
5. Use a large prosthetic material to reinforce the inguinal floor permanently.

Rate of recurrence is variable after the hernia repair and hence consideration about the initial repair is utmost important. The choice of anterior vs. posterior open approach is guided by the initial repair. The prior tissue repair is followed by either the anterior or posterior approaches for recurrent hernia repair. The failed prior mesh repair, is followed by recurrent repair in the space in which the architecture of the planes are maintained. Careful dissection to avoid the devascularization of testes and also avoid injury to the vas deferens and the associated nerve structures has to be always considered.



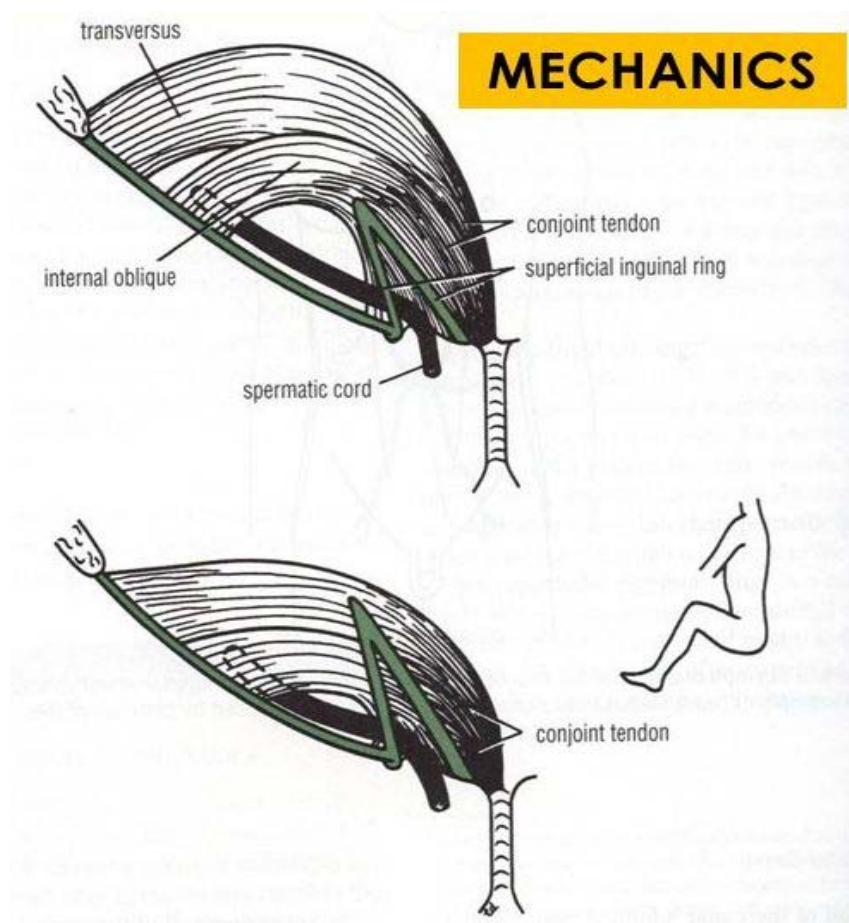
A failed prior tissue repair is followed by the mesh repair with due respect to the Lichtenstein postulates. The mesh is usually severely adherent and fibrosed to the cord structures and the surrounding tissues. The need for orchidectomy is rare. The prosthesis is found adherent and fibrosed to the vital structures. The Prolene Hernia System done through an anterior approach places mesh both anterior and also posterior to the fascia transversalis. Minimally invasive, a complete view of all hernial defects and less postoperative pain are the advantages of a lap repair but presence of Mesh in the space can make the repair challenging. Any difficulty puts the vessels in danger and these candidates are better to be taken up for open procedure.

PROTECTIVE MECHANISMS THAT PREVENT INGUINAL HERNIA

- **The Obliquity of the inguinal canal**, when increase in the intra abdominal pressure the posterior wall is apposed to the anterior wall and thus prevents contents herniating.
- **Sphincter action of transverse abdominis and internal oblique muscles** at the deep inguinal ring. There is transversalis fascial sling which is derived from the transversalis fascia and this sling reinforces the medial and inferior margin of the ring. Transversus abdominis contracts it pulls the sling superiorly and laterally. This acts both to close the deep inguinal ring around the cord and to pull the deep inguinal ring superiorly and laterally.
- **Ball Valve Mechanism of the Cremaster muscle** which pulls spermatic cord into the canal and plugs it during increase in intra abdominal pressure.
- In front of the internal inguinal ring there are **strong fibres of the internal oblique muscle**, this prevents entry of any content through the deep ring.
- **Strong conjoint tendon is there in front of the Hesselbach's triangle** to prevent a direct hernia.
- **Shutter mechanism of the arched fibres** of the internal oblique and the transversus abdominis will bring the muscles down towards the floor when they are contracted during increase of intra abdominal pressure.

MATERIALS AND METHODS

The change in posture from prone to upright has caused reduction in efficiency of shutter mechanism of inguinal canal leading to the development of inguinal hernia. The low pubic arch group shows a significantly longer inguinal ligament and a greater angle made by the superior border of the suprainguinal space and the inguinal ligament at its medial insertion.



The lower the pubic tubercles, the more often morphological alterations are found in the external oblique, internal oblique, transversus, cremasteric muscles and the fascia transversalis. The shutter-like mechanism at the internal inguinal ring is provided by contraction of the arching fibers of the internal oblique, which, when shortened, approximate themselves to the inguinal ligament and compress the spermatic cord. The unusual origin and insertion of internal oblique and transverses abdominis muscle, results in an ineffective shutter mechanism of the inguinal canal. The origin of the internal oblique from the inguinal ligament far away from the pubic tubercle and its lower fibers not covering the deep ring has been postulated in the indirect inguinal hernia. The various degree of incompleteness of the internal oblique in the inguinal region leads to the essential predisposition to the direct inguinal hernia. Other factors are an increase in the size of the Hessert's triangle.

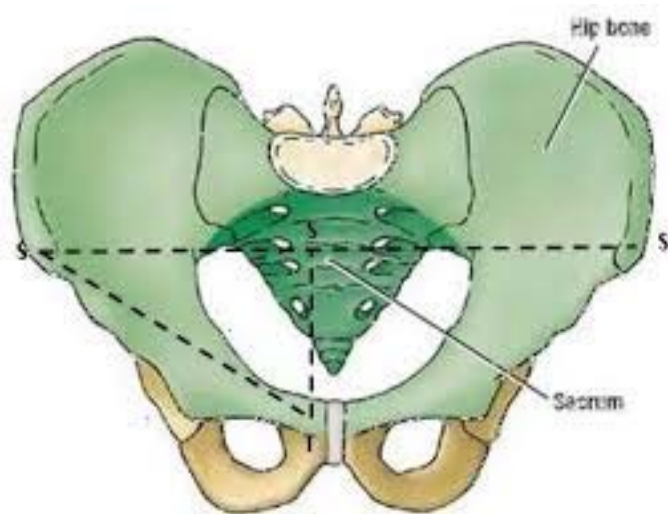
The study classifies the subjects as (Group I) “High lying pubic tubercle” i.e. those with ST line less than or equal to 7.5 cm and (Group II) “Low lying pubic tubercle” i.e. those with ST line more than 7.5 cm. concluded that the low lying pubic tubercle was a predisposing factor for inguinal hernia. So we can state that the functional significance of the inguinal region is modified by bony, ligament and muscular variations and therefore the identification of the structural characteristics enables the surgeon to perform the appropriate surgical technique. Thus this anthropometric study of pelvis will enable the surgeons to categorize people with low lying pubic tubercle more liable for hernia that could help in life style modifications and if developed an inguinal hernia to go for a more appropriate repair technique.

Materials used:

1. Skin marker
2. Inch tape

Methodology:

The study subjects are asked to lie in supine relaxed position on hard bed. Keeping both lower limbs straight, so that both the anterior superior iliac spines are at the same level. A line is drawn on the anterior abdominal wall. Connecting both anterior superior iliac spine which is given the name SS Line and the length of SS Line is noted; next the pubic tubercle on the side of hernia is marked by the palpation. Then vertical distance between this point and the SS Line is measured in centimeters. This line is designated as ST line. Similar measurement is done on controls as well.



OBSERVATIONS AND RESULTS

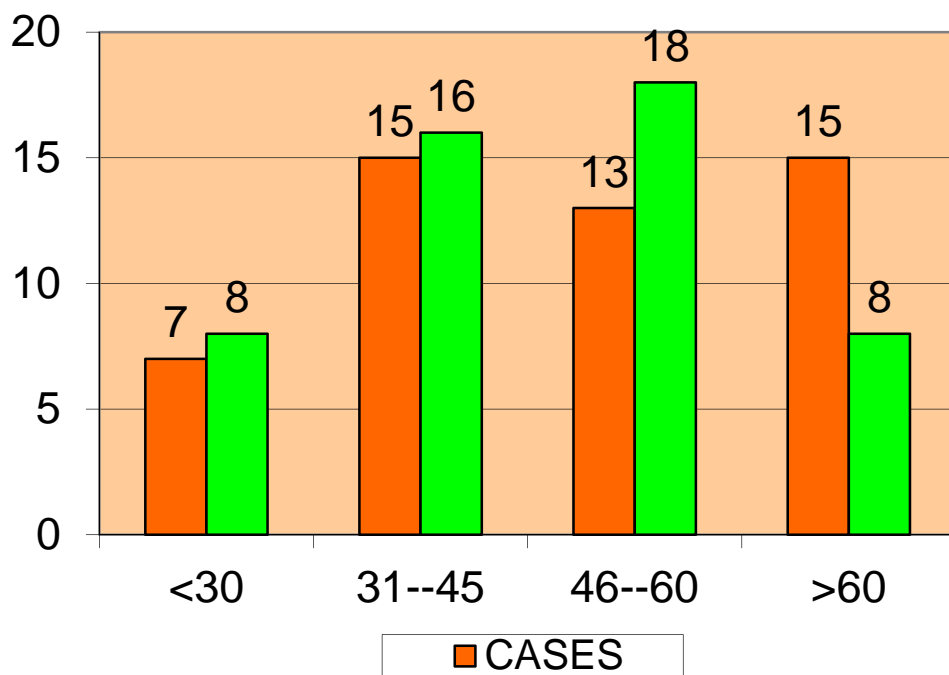
Comparison of the age of the cases and controls

AGE	CASES	CONTROL
≤30	7	8
31—45	15	16
46—60	13	18
>60	15	8
TOTAL	50	50
Mean	49.42	46.46
SD	15.288	14.551
P'Value	0.324	Not sig

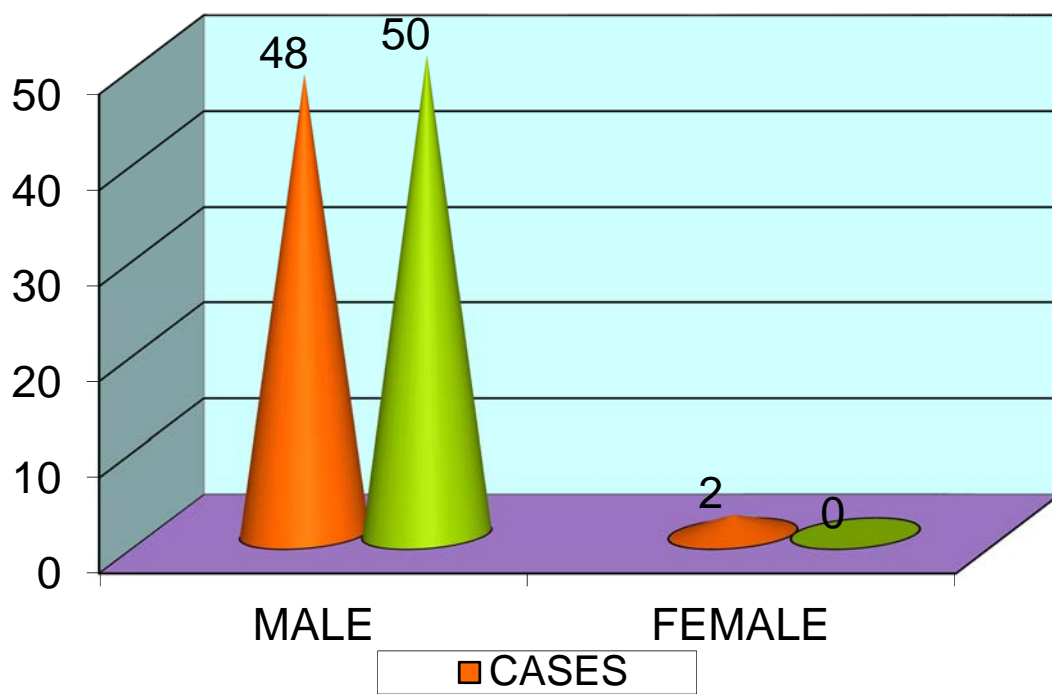
Comparison of the sex of the cases and controls

SEX	CASES	CONTROL
MALE	48	50
FEMALE	2	0
TOTAL	50	50
P'Value	0.999	Not sig

AGE DISTRIBUTION



GENDER DISTRIBUTION



COMPARISON OF THE SS LENGTH OF CASES AND CONTROL

SS LENGTH	CASES	CONTROL
≤ 23	0	22
23.1--24	4	22
> 24.0	46	6
TOTAL	50	50
Mean	26.15	23.212
SD	0.987	0.63
P'Value	<0.001	Significant

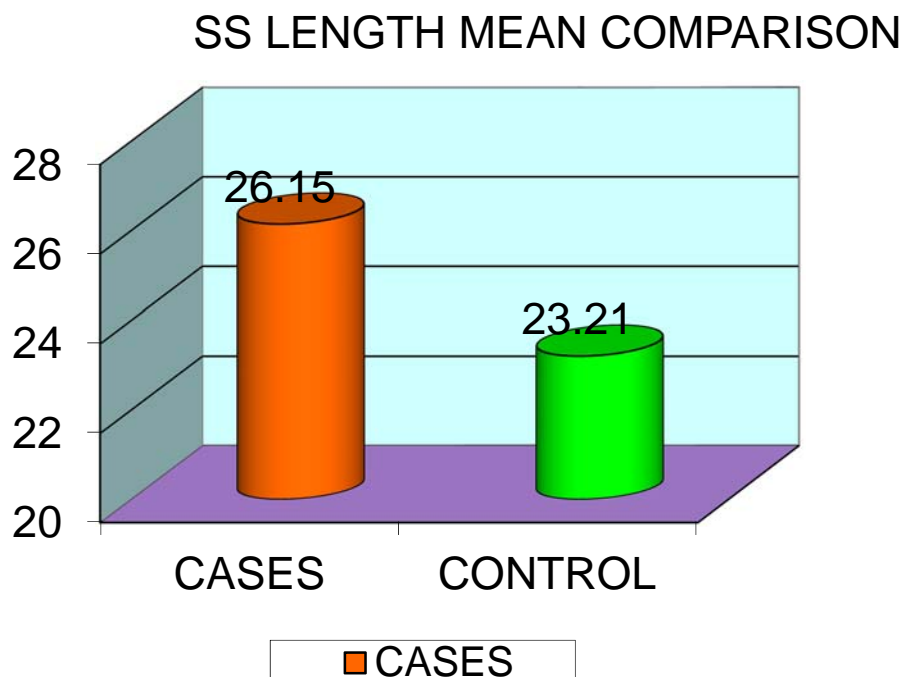
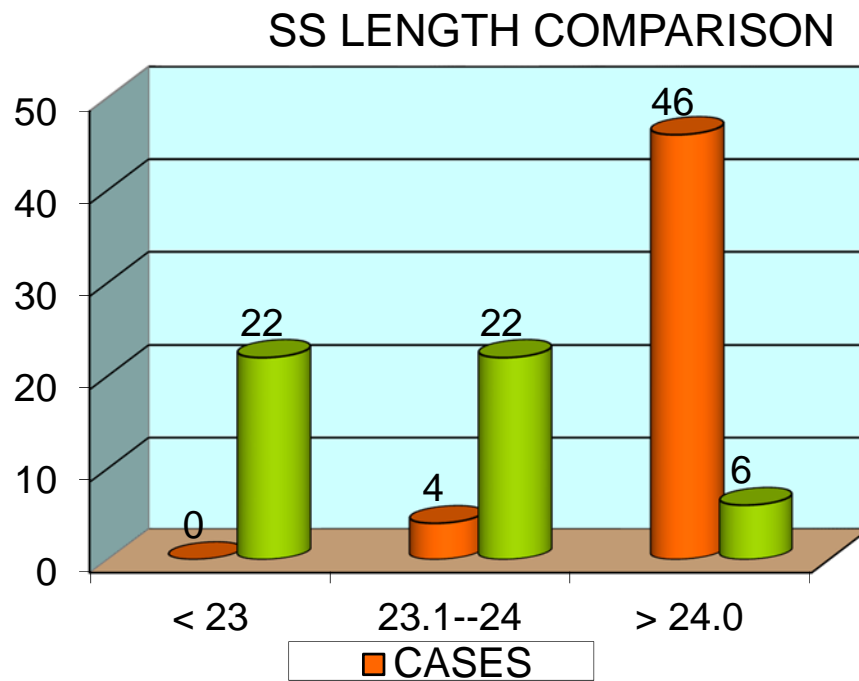
SS LENGTH	CASES	CONTROL
Mean	26.15	23.21

COMPARISON OF THE ST LENGTH OF CASES AND CONTROLS

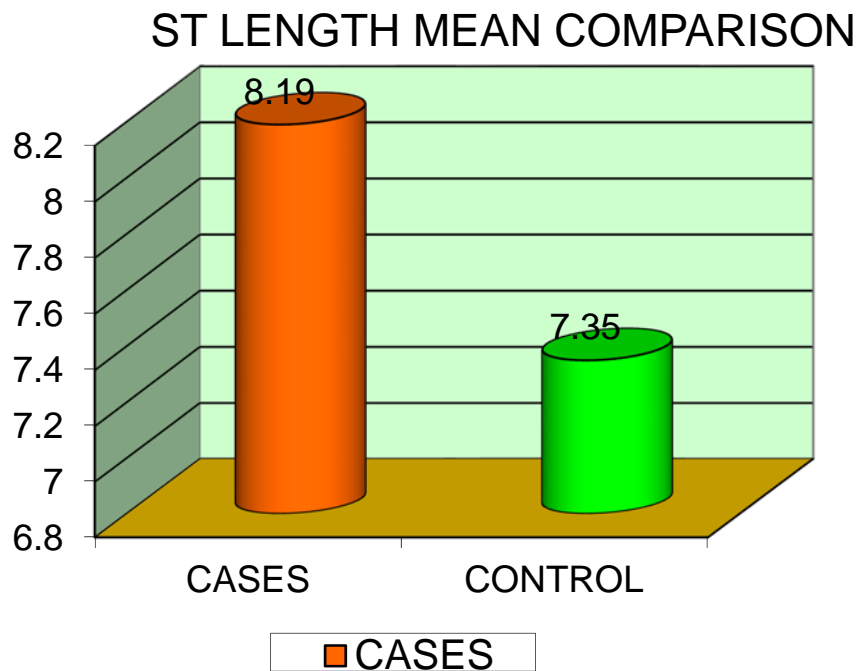
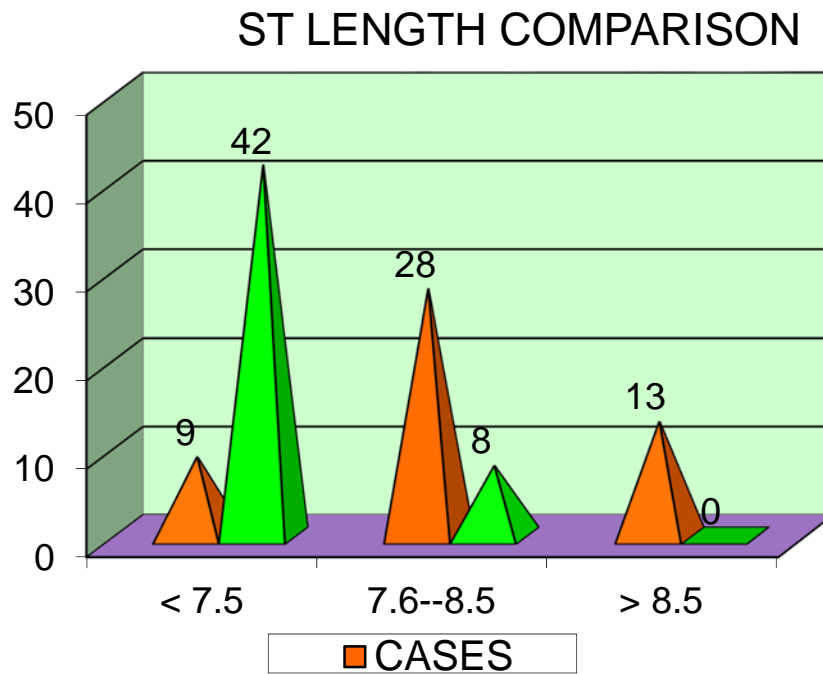
ST LENGTH	CASES	CONTROL
≤ 7.5	9	42
7.6--8.5	28	8
> 8.5	13	0
TOTAL	50	50
Mean	8.186	7.352
SD	0.61	0.23
P'Value	<0.001	Significant

ST LENGTH	CASES	CONTROL
Mean	8.19	7.35

Comparison of the SS length of the cases and controls



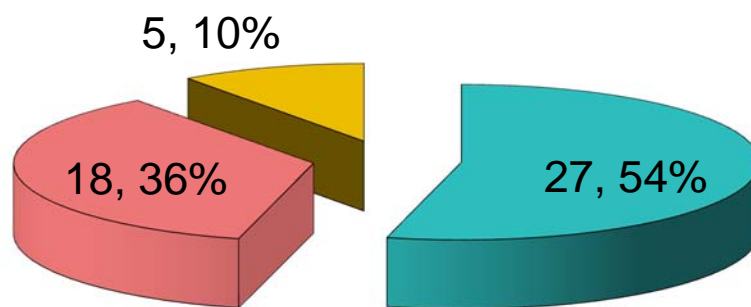
Comparison of the ST length of the cases and controls



COMPARISON OF THE TYPES OF INGUINAL HERNIA

TYPE	CASES
Direct	27
Indirect	18
Pantaloon	5
TOTAL	50

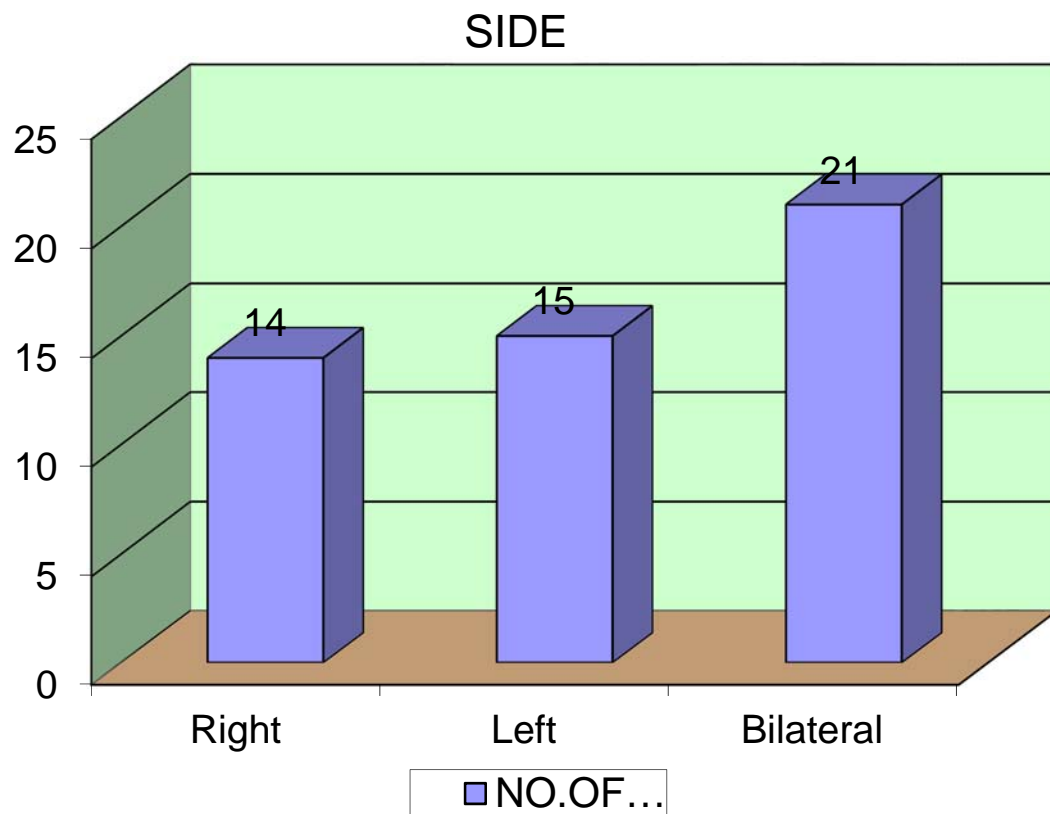
TYPE



■ Direct

COMPARISON OF THE SIDES OF INGUINAL HERNIA

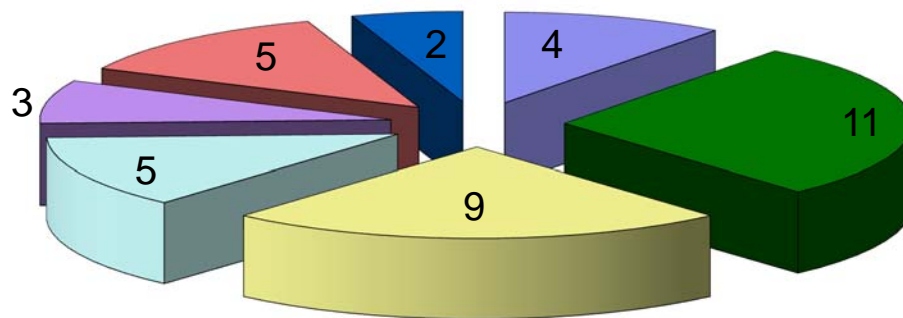
SIDE	NO.OF CASES
Right	14
Left	15
Bilateral	21
TOTAL	50



COMPARISON OF THE ASSOCIATED RISK FACTORS

Associated Risk factors	NO.OF CASES
ABDOMINAL MASS	4
BPH	11
SMOKER	9
CHRONIC COUGH	5
CONSTIPATION	3
OBESE	5
PREV. SURGERY	2

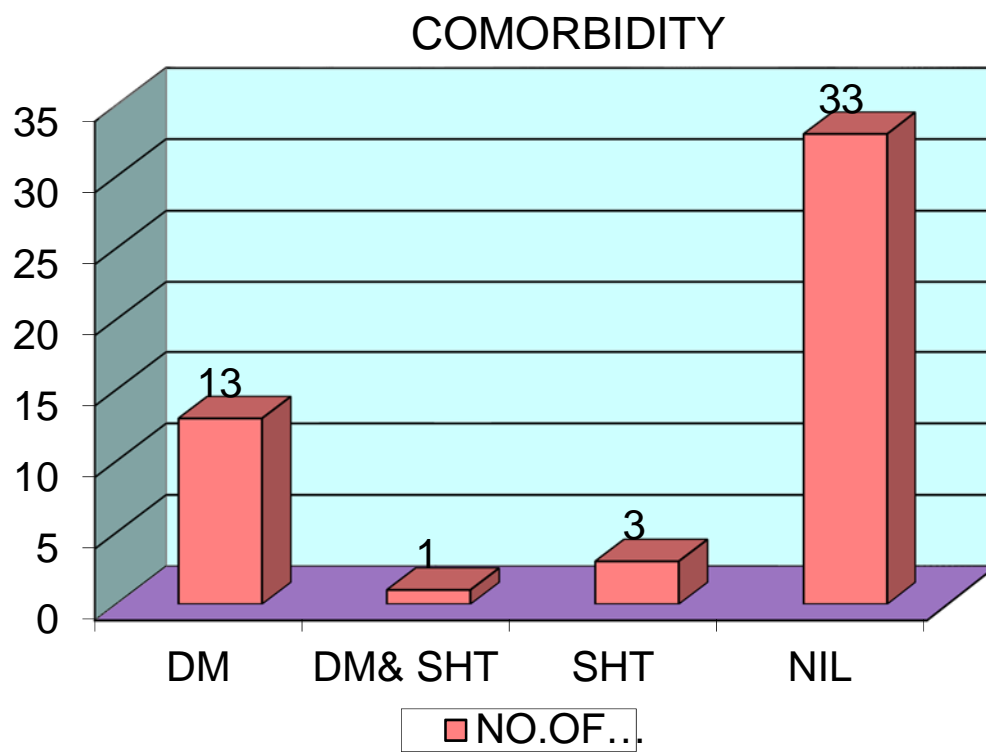
ASSOCIATED RISK FACTORS



ABDOMINAL MASS	BPH
SMOKER	CHRONIC COUGH
CONSTIPATION	OBESE

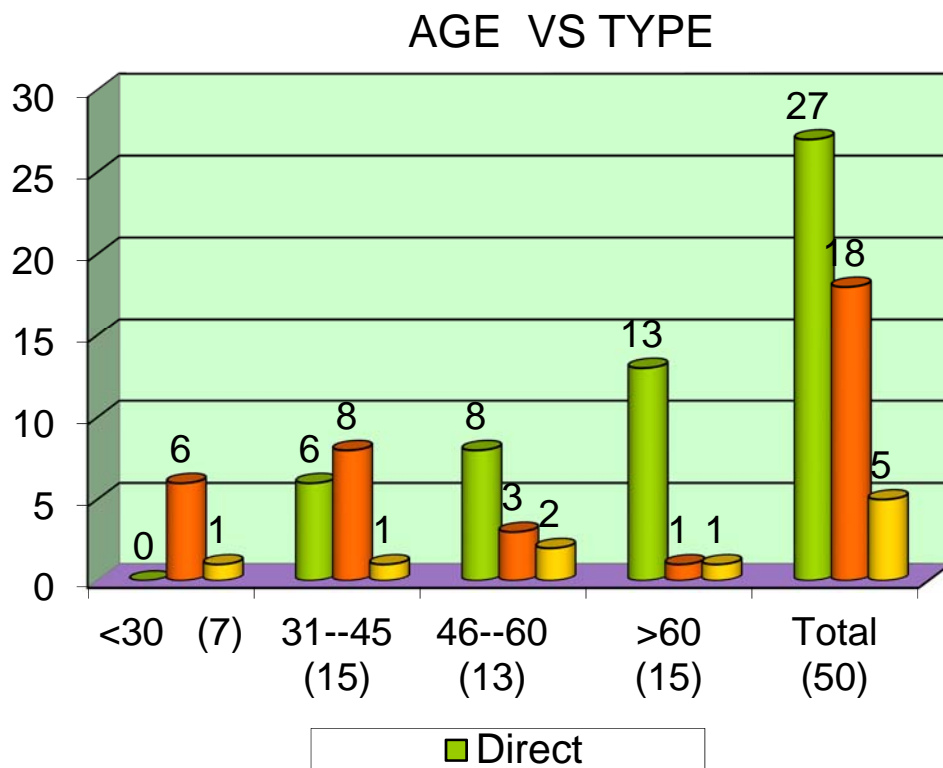
COMPARISON OF THE ASSOCIATED CO-MORBIDITIES

COMORBIDITY	NO.OF CASES
DM	13
DM& SHT	1
SHT	3
NIL	33
TOTAL	50



COMPARISION OF AGE VS TYPE OF THE INGUINAL HERNIA

AGE	Direct	Indirect	Pantaloon
≤30 (7)	0	6	1
31--45 (15)	6	8	1
46--60 (13)	8	3	2
>60 (15)	13	1	1
Total (50)	27	18	5



DISCUSSION

The failure of the shutter mechanism can lead to the increased risk of inguinal hernia both direct and indirect. The present study mainly focused on the ST and the SS length of the same age group of patients admitted with inguinal hernia as cases and other diseases as controls in the Govt. Rajaji Hospital. Fifty cases and controls were selected and after a written consent were taken up for the study.

The SS length of the controls were measured in the above said manner and observed a mean of 23.212 cm with only 6 controls having a SS length of more than 24 cm, while the cases on the other side had a mean of 26.15 cm with nearly about 46 cases having a SS length greater than 24 cm with no cases below 23 cms and about 4 cases between 23 to 24 cms. The SD value of cases was 0.987 compared with SD of 0.63 of the controls. The p value is <0.001 that is found to be significant.

The ST length of the controls were measured in the above said manner and observed a mean of 7.352 cm with 8 controls having a ST length of more than 7.5 cm, while the cases on the other side had a mean of 8.2 cm with nearly about 28 cases having a ST length greater than 8 cm and about 13 cases having a ST length of more than 8.5 cm. The SD value of cases was 0.61 compared with SD of 0.23 of the controls. The p value is <0.001 that is found to be significant.

When these values were compared with the previous studies showed similar results to that of the Mehul agrawat et al of 2014 of Central India where the mean SS

length of the study was found to be 23.7 cm and 26.3 cm among the controls and cases of the study respectively while the ST length of the study was 9.06 cm and 7.2 cm among the cases and controls respectively. The values were also consistent with the Thaeer Farhan et al of Iran and the ST length was 6.5 and 7.8 in his study. This clearly proves the significance of the anthropometric value of low lying pubic tubercle in the development of inguinal hernia.

The study of the secondary objectives of the study included comparison of the age, sex, type, side, associated risk factors and co morbidity. A comparative study has also been made between age and types of the patient. On comparing the age of the patients, the most common age group was the group between 31 years to 45 years and group greater than 60 years of age. On comparing the sex index out of the 50 cases only two female cases were reported.

Out of the cases of 50 in number, 27 cases were reported to have direct inguinal hernias, 18 cases had indirect inguinal hernia and 5 cases were found to be pantaloon hernia. Thus the most common inguinal hernia according to the study is direct inguinal hernia. On comparing the age group with the type of inguinal hernia, the previous studies and literature have been proved, in the age group of greater than 60 years of age the number of direct hernia was 13 and only one indirect hernia. In the age group of less than 30 years of age there was no incidence of direct while the indirect hernia was about 6 in number. The incidence of indirect was more in the 31 to 45 years age group compared to the direct while the next age group of 46 to 60 had a shift towards from the direct inguinal hernia.

A study on the associated risk factors showed that difficulty in micturition for a prolonged period still remains to be the most common cause for inguinal hernia. Benign prostatic hypertrophy was the most common cause found to be associated with micturition difficulty and it was more common in the old age and this was followed by an increased incidence of inguinal hernia among the smokers. Smoking causes change in the collagen architecture causing an increased risk and chronic cough was found to be the third associated factor with about 5 cases and constipation with 3 cases.

Obesity causing fat infiltration in the muscle fibres and about 5 cases, who had a BMI more than 35, have also been reported in the study. History of previous surgery was 2 in number and in both cases; surgery performed was open appendicectomy by a grid iron incision. The presence of abdominal mass causing a raised intraabdominal pressure also accounts to be significant risk factors with 4 numbers of cases reported.

Among prior co morbidities there was a well established incidence of inguinal hernia among the diabetes patients, where 13 cases of diabetes has been reported among the case group. Neuropathy and glycosylation of tissues could be the explainable reasons for the increase in the incidence of the inguinal hernia.

CONCLUSION

The study thus throws light over the significance of the low lying pubic tubercle in relation to the inguinal hernia. The study proved the significance of the anthropometry of the pubic tubercle in both direct and indirect inguinal hernia. The defective shutter mechanism due to the low lying pubic tubercle has been well established. This study thus could help in the intervention of inguinal hernia.

Any patient with an increased ST length is at a increased risk of developing an inguinal hernia in the course of his life, thus these patients can be advised for a lifestyle modification, if they are indulged in weight lifting or other strenuous activities. Also if young patients are treated for inguinal hernia, a note of the pubic tubercle status has to be considered if it is found to be low lying, a hernioplasty would be more beneficial than a herniorraphy as they are at a increased risk to develop a direct hernia in their lifetime.

Though many other objectives studied have followed the literature. The study shows an increase in the incidence of inguinal hernia among diabetic patients. A good glycemic control and a life style modification is a must among these patients to overcome complications of recurrence and other external hernias.

Thus the study significantly establishes the role of pelvic anatomy in the incidence of inguinal hernia. The aims and objectives have been well studied.

ANNEXURES

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PROFORMA

Name: I. P. No;

Age: - Unit;

Sex: - D.O.A;

Occupation: - D.O.D;

Address: - D.O. surgery;

CHIEF COMPLAINTS:

- 1) Swelling
- 2) Pain
- 3) Other complaints

HISTORY OF PRESENTING ILLNESS:

1) SWELLING:

- a. Duration
 - b. mode of onset
 - c. starting site
 - d. aggravating and relieving factors
 - e. associated pain
- History of vomiting, constipation, fever
 - History of precipitating factors like difficulty in micturition, defecation, Chronic cough, weight lifting

PAST HISTORY

- 1) History of previous surgeries
- 2) History suggestive of Hypertension/ Diabetes/ Tuberculosis/ asthma

PERSONAL HISTORY

Diet: Vegetarian/ Mixed

Habits: Smoking/ Alcohol/ Tobacco

Bowel and bladder habits

FAMILY HISTORY

Similar illness in other family members

GENERAL PHYSICAL EXAMINATION

1. General survey
2. Body build and nourishment
3. Height
4. Weight
5. Dehydration: Mild/ Moderate/ Severe/ Nil
6. Anemia/ Jaundice/ Clubbing/ Cyanosis/ Lymphadenopathy/ Pedal oedema
7. Pulse
8. Temperature
9. Respiratory rate
10. Blood pressure

LOCAL EXAMINATION

1. INSPECTION

- Site
- Size
- Shape
- Extent
- Skin over the swelling
- Visible peristalsis
- Cough impulse

2. PALPATION

- Local rise of temperature
- Tenderness
- Situation
- Size and shape
- Extent
- Skin over swelling
- Surface and margins
- Consistency
- Reducibility
- Get above the swelling
- Cough impulse
- Invagination test
- Ring occlusion test
- Zieman's technique

EXAMINATION OF LYMPH NODES

EXAMINATION OF GENITALIA

Testis

Epididymis

Penis

Regional nodes

Opposite groin

RECTAL EXAMINATION

SYSTEMIC EXAMINATION

- Cardiovascular system
- Respiratory system
- Central nervous system
- Abdominal examination
 - Mass abdomen
 - Malgaigne s bulging
 - Ascites

INVESTIGATIONS

1. Blood: Hb %
2. TLC
3. DLC
4. BT
5. CT
6. ESR
7. Blood group and Rh type
8. Urine: Albumin/ Sugar/ Microscopy
9. Chest x-ray
10. HIV
11. USG ABDOMEN
12. SS LENGTH (Distance between two anterior superior iliac spines)

13. ST LENGTH (Distance between pubic tubercle and SS line)

DIAGNOSIS

PERFORMA

[illegible]

LIST OF CONTROLS TAKEN UP FOR THE STUDY ON THE SIGNIFICANCE OF LOW LYING PUBIC TUBERCLE ON INGUINAL HERNIA

S.No.	NAME	AGE (in yrs)	SEX	Ip.No.	DIAGNOSIS	SS LENGTH (in cms)	ST LENGTH (in cms)
1	Ramar	70	M	1143028	Epigastric Hernia	22.8	7.2
2	Selvamani	36	M	13533	Traumatic ulcer foot	24.6	6.9
3	Ajith	24	M	1142478	Gonococcal Urethritis	22.7	7.3
4	Adaikalan	32	M	1142396	Ca stomach	23.6	7.8
5	Ramanthan	54	M	1142384	Diabetic foot	22.4	7.3
6	Periyasamy	56	M	1142388	Ca stomach	23.7	7.2
7	Muthusamy	65	M	1142382	Fissure in Ano	22.4	7.3
8	Sivagurunathan	28	M	55935	Diabetic foot	23.8	7.4
9	Mariyappan	53	M	1141925	BCC	23.5	7.4
10	Pasupathi	24	M	55673	Cystitis	24.1	7.6
11	Thangavel	65	M	1141405	Chronic DVT	23.6	7.4
12	Pazhani	55	M	1143191	Balaposthitis	22.4	7.4
13	Mayandi	45	M	55782	Iloecaecal TB	22.6	7.1
14	Agini	50	M	59322	Appendicular mass	22.4	7.2
15	Subramanian	76	M	55723	Chronic DVT	23.6	7.4
16	Soukath Ali	43	M	55713	Alcholic gastritis	23	7.3
17	Karuthapandi	60	M	55714	Fistula in ano	23.5	7.3
18	Srinivasan	45	M	55715	gluteal abscess	22.8	7.2
19	Marimuthu	35	M	1140199	cellulitis forearm	23.7	7.7
20	Mani	54	M	1140311	Hydrocele	22.5	7.4
21	Murugesan	54	M	1140196	Cholelithiasis	24.2	8
22	Kalaiaarasan	23	M	1140155	testicular tumor	23.2	7.4
23	Balaji	47	M	1139355	Left ureteric calculus	22.7	7.3
24	Sakthivel	71	M	58846	Pressure sore	23.4	7.4
25	Sekar	60	M	58813	Liver abscess	22.6	7.3
26	Karthiksamy	34	M	1138662	Hepatocellular Ca	22.3	7.2

LIST OF CONTROLS TAKEN UP FOR THE STUDY ON THE SIGNIFICANCE OF LOW LYING PUBIC TUBERCLE ON INGUINAL HERNIA

S.No.	NAME	AGE (in yrs)	SEX	Ip.No.	DIAGNOSIS	SS LENGTH (in cms)	ST LENGTH (in cms)
27	mariyappan	47	M	1138115	Varicose veins	23.8	7.6
28	Sanjeevi	23	M	1138059	Phimosis	23.2	7.4
29	Karanthamalai	24	M	1136845	ureteric calculus	24.4	7.3
30	Kathiresan	54	M	1136635	Verrucous Ca	23.1	7.4
31	Shanmugaraj	63	M	57830	PAOD	22.5	7.3
32	Bagirathan	45	M	1135073	Rectal ulcer	22.4	7.4
33	Karnan	23	M	1133841	ingrowing toe nail	23.4	7.7
34	Jayaraj	52	M	1131066	Cahead of pancreas	24	7.8
35	Arun	43	M	1132426	Lipoma back	23	7.2
36	Muthusankar	32	M	1131296	Haemorrhoids	23.4	7.3
37	Sankar	37	M	1131261	Recurrent appendicitis	23.4	7.4
38	sethu	40	M	49969	Liver abscess	22.6	7.3
39	veerannan	50	M	1129907	Pleomorphic adenoma	23.5	7.5
40	Ibrahim	52	M	49556	Varicocele	23	7.4
41	Bahiravan	31	M	1128818	Ca rectum	22.5	7.3
42	Kalimuthu	34	M	1127383	Chronic pancreatitis	24.1	7.7
43	Muthusamy	71	M	1127219	MNG Thyroid	23.4	7.3
44	Ravichandran	37	M	1125711	Varicose veins	22.7	7.3
45	Kathiresan	60	M	1124469	Hepatoma	22.4	7.4
46	Raja	52	M	1124577	Cholecystitis	24.5	7
47	Navaneedhan	60	M	1124495	Diabetic foot	23.5	6.9
48	Shanmugam	62	M	1124505	Ca Penis	23.6	6.7
49	Jaganathan	30	M	1123081	Sublingual sialadenitis	23.4	7.4
50	Arokyaraj	42	M	1114117	Orchitis	22.7	7.2

LIST OF CASES SELECTED FOR THE STUDY ON SIGNIFICANCE OF LOW LYING PUBIC TUBERCLE ON INGUINAL HERNIA

S.No.	NAME	AGE (in yrs)	SEX	Ip.No.	TYPE	SIDE	SS LENGTH (in cms)	ST LENGTH (in cms)	ASSOCIATED RISK	MORBIDITY
1	Pandi	72	M	1140369	Direct	Right	26.4	8.4	BPH	DM
2	Thangaraj	35	M	1140186	Indirect	Left	25.9	8.5	Nil	Nil
3	Muneeswaran	45	M	1133879	Direct	Bilateral	26.5	7.8	Old PTB	Nil
4	Mani	35	M	1138051	Direct	Bilateral	25.8	7.7	Nil	DM
5	Pandi	41	M	1137610	Pantaloon	Left	24	7.4	BPH & Smoker	DM
6	Dhanapal	34	M	1136834	indirect	right	25.5	7.6	Nil	Nil
7	Pitchai	75	M	1136360	direct	Bilateral	26.3	8.4	PHT	SHT
8	Karuppaia	55	M	1134402	indirect	Right	26.7	8.8	Nil	Nil
9	Manikkam	76	M	1134357	Direct	Bilateral	26.5	8.5	Abd. Mass	Nil
10	Innasimuthu	57	M	1133861	indirect	Left	26.7	8.4	BPH	DM
11	karuppaia	57	M	1132913	direct	Bilateral	23.5	7.2	Nil	Nil
12	Azhagusivam	37	M	57418	indirect	Bilateral	25.7	7.6	Constipation	Nil
13	Prabhakaran	24	M	1131261	indirect	Right	26.6	7.9	Nil	Nil
14	Malaisamy	62	M	1125012	Pantaloon	Bilateral	26.4	7.8	COPD & Smoker	Nil
15	Addaikan	70	M	1129892	Direct	Bilateral	25.4	8.4	Ca Lung & Smoker	Nil
16	vishwa	20	M	1129768	indirect	Right	26.3	8.7	Nil	Nil
17	Asaithambi	27	M	1129191	indirect	Right	26.8	8.9	nil	Nil
18	nagaraj	Y	M	1128926	indirect	Left	27	9.1	Obese & Smoker	Nil
19	Ochu	65	M	1128820	direct	Left	26.4	9	COPD & Smoker	Nil
20	Sollaipandi	55	M	1128700	Direct	Left	23.6	7.3	Nil	DM
21	Muthu	61	M	49218	Direct	Bilateral	27.2	9.1	BPH & Smoker	Nil
22	Murugesan	60	M	1127159	Pantaloon	Bilateral	25.7	8.8	BPH	Nil
23	Ellapan	60	M	1122710	Direct	Bilateral	26.7	8.3	Nil	DM
24	Jayamoorthy	24	M	1127144	Indirect	Left	26.4	8.5	Smoker	Nil
25	Muthusamy	63	M	1126493	Direct	Right	27.1	9.4	BPH	NIL
26	Ashok	26	M	1125714	Indirect	Left	27.8	8.4	nil	Nil
27	Parimala	35	F	1125762	Indirect	Right	26.5	7.9	Nil	DM

LIST OF CASES SELECTED FOR THE STUDY ON SIGNIFICANCE OF LOW LYING TUBERCLE ON INCIDENCE OF INGUINAL HERNIA

S.No.	NAME	AGE (in yrs)	SEX	Ip.No.	TYPE	SIDE	SS LENGTH (in cms)	ST LENGTH (in cms)	ASSOCIATED RISK	MORBIDITY
28	Raja	45	M	1125707	Direct	Left	26.8	8.5	BPH	Nil
29	Karuppan	45	M	1125671	Indirect	Bilateral	26.2	7.5	constipation	Nil
30	Senthil	35	M	1125614	Indirect	Left	25.9	8.1	COPD	nil
31	Chandrakumar	28	M	1125593	Indirect	Right	26.3	7.9	nil	nil
32	Noorjahan	45	F	1124659	Indirect	Left	26.5	7.5	Constipation	DM
33	Sekar	46	M	1123675	Direct	Bilateral	f	7.1	obese	nil
34	Ganesan	46	M	1122814	Direct	Left	26.5	7.6	nil	nil
35	Kannappan	63	M	1122791	Direct	Right	26.8	8.6	BPH	DM
36	Subbaiyah	60	M	1122188	Pantaloon	Left	27.2	8.5	nil	SHT
37	Pazhanivel	43	M	1121390	Direct	Right	25.6	7.6	Smoker	nil
38	Gubendran	40	M	1120074	Direct	Bilateral	26.2	7.8	nil	nil
39	Chinnathambi	65	M	1118598	Direct	Bilateral	26.3	8.5	BPH & obese	SHT
40	Arokianathan	53	M	1118595	Direct	Right	26.4	8.7	BPH	DM
41	Ammaiyappan	40	M	1116967	Direct	Bilateral	28	9.3	prev. Surgery	nil
42	Marimuthu	34	M	1116907	Indirect	Bilateral	26.5	8.5	Abd. Mass	nil
43	Muniyandi	53	M	1115208	Direct	Bilateral	24.3	7.3	obese	DM
44	Ramu	67	M	1114169	Direct	Bilateral	23.9	7.4	obese	DM& SHT
45	Ganapathy	63	M	1114134	Direct	Bilateral	25.6	7.9	Abd. Mass	DM
46	Emappan	65	M	10550932	Indirect	Bilateral	26.4	8.3	nil	nil
47	Chanrasekar	54	M	1056629	Direct	Left	26.7	7.8	Smoker	nil
48	Maduraiveeran	61	M	1058206	Direct	Left	26.4	8.8	BPH	DM
49	Perumal	27	M	1059130	Pantaloon	Right	27.2	9	prev. surgery	nil
50	Suresh	35	M	1061283	Direct	Right	24.2	7.3	nil	nil

CHRONIC COUGH: COPD, Ca lung	DM - Diabetes mellitus
Chronic Constipation	SHT - Systemic Hypertension
Abdomen mass	Smoking
BPH - Benign hypertrophy of prostate	Obesity



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INTRODUCTION

The muscles, fascia and bones forms a complex structure called as the abdominal wall. Apart from the chief role of protecting the vital organs from external environment especially gastrointestinal and urogenital tract, also has a chief role in the mobility of the body like extension, rotation, flexion and change the wall capacity. Stretch and elasticity are the two major determinants of flexibility at the cost of the strength of the abdominal wall. The thoracic cavity is of negative pressures while the abdominal cavity which is positive pressure and they are separated by the diaphragm. The bowel may enter the thoracic cavity if the wall turns weak.

The lower part of the abdominal cavity is bounded by the bony pelvis, though strong has a central portion called as the perineum which may turn weak leading to the descend of pelvic and gynecological organs a condition called as the prolapse. Posteriorly the muscles of the wall are taut, further supported by the vertebral column, pelvis along with the ribs. Lumbar hernias are special entity of external hernias that occur through two zones of weakness called as the posterior triangles. In the lateral part of the abdominal wall, there are three muscle fibres which criss cross over each other to provide strength to the lateral wall of the abdominal wall. Surgeons use these layers for making incisions for surgery and making an overlapping repair of these muscle fibres, will increase the girth and help to close defects of the centre of the abdominal cavity.

From ribs to the bony pelvis extend two strong muscles called as the rectus abdominis of the central part of the abdomen. Though they are taut muscles, their central

Match Overview

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**ETHICS COMMITTEE
 CERTIFICATE**

Name of the Candidate : Dr.Yashwanth pradeep
 Course : PG in MD., General Surgery
 Period of Study : 2014-2017
 College : MADURAI MEDICAL COLLEGE
 Research Topic : Significance of low lying pubic
 tubercle in the development of
 inguinal hernia
 Ethical Committee as on : 27.07.2016

The Ethics Committee, Madurai Medical College has decided to inform
 that your Research proposal is accepted.

Member Secretary

Chairman

Dean / Convenor

